

# Popular Science

FOUNDED **MONTHLY** 1872



*Strange New Plane Shaped  
like a Sea Gull ~ page 44*

**GENE TUNNEY TELLS HOW HE BEAT DEMPSEY**

**DECEMBER**

*See Page 28*

**25 CENTS**



# New! The

# MULTICOLOR MECCANO

## Now you can build models in colors!

You've never seen anything like it, fellows! Look at the beautiful models on this page with their lustrous coloring—all made with the new Multicolor Meccano. Part after part gleams with brilliant colors, that's why the models are so realistic. And all the fine engineering quality for which Meccano has always been famous, is still there.

We wanted the best colors we could find so we selected Duco, the same genuine Duco that is used on the finest automobile bodies—you'll probably find it on Dad's new car. This gives a hard tile-like finish that does not crack or peel like ordinary paints. And Duco-finished parts *cannot* rust.

Get the newest thing in construction toys. Building with Meccano is dead easy. No study required. Build your models in bright colors—flaming red for the Fire Engine, olive green for the Tank Car—only Multicolor Meccano gives you this, yet it costs no more.

You'll certainly give the gang a surprise when you display your up-to-the-minute Multicolor outfit. No more colorless, dull models for you—be a leader! This is the day of the new Multicolor Meccano.

*There are sets from \$1.00 to \$45.00. Two dandy specials at \$5 and \$10 include motors. See them at your dealers.*

### Send for this Free Book

It's an interesting story entitled, "How Jack Discovered the Perfect Toy." It will tell you all about the new Multicolor Meccano. Sent free for your name and address and those of three of your chums. Put No. K-2 after your own name for reference.

MECCANO COMPANY, INC., Div. K-2,  
Elizabeth, N. J.

In Canada: Meccano Ltd., 45 Colborne St., Toronto



*Special No. 3x Outfit — ~~\$11.50~~*

*Reduced to \$10.00*

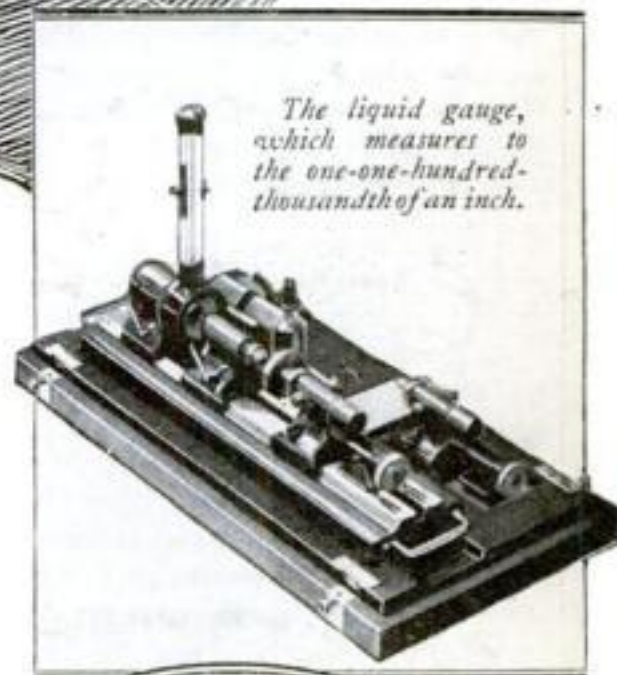
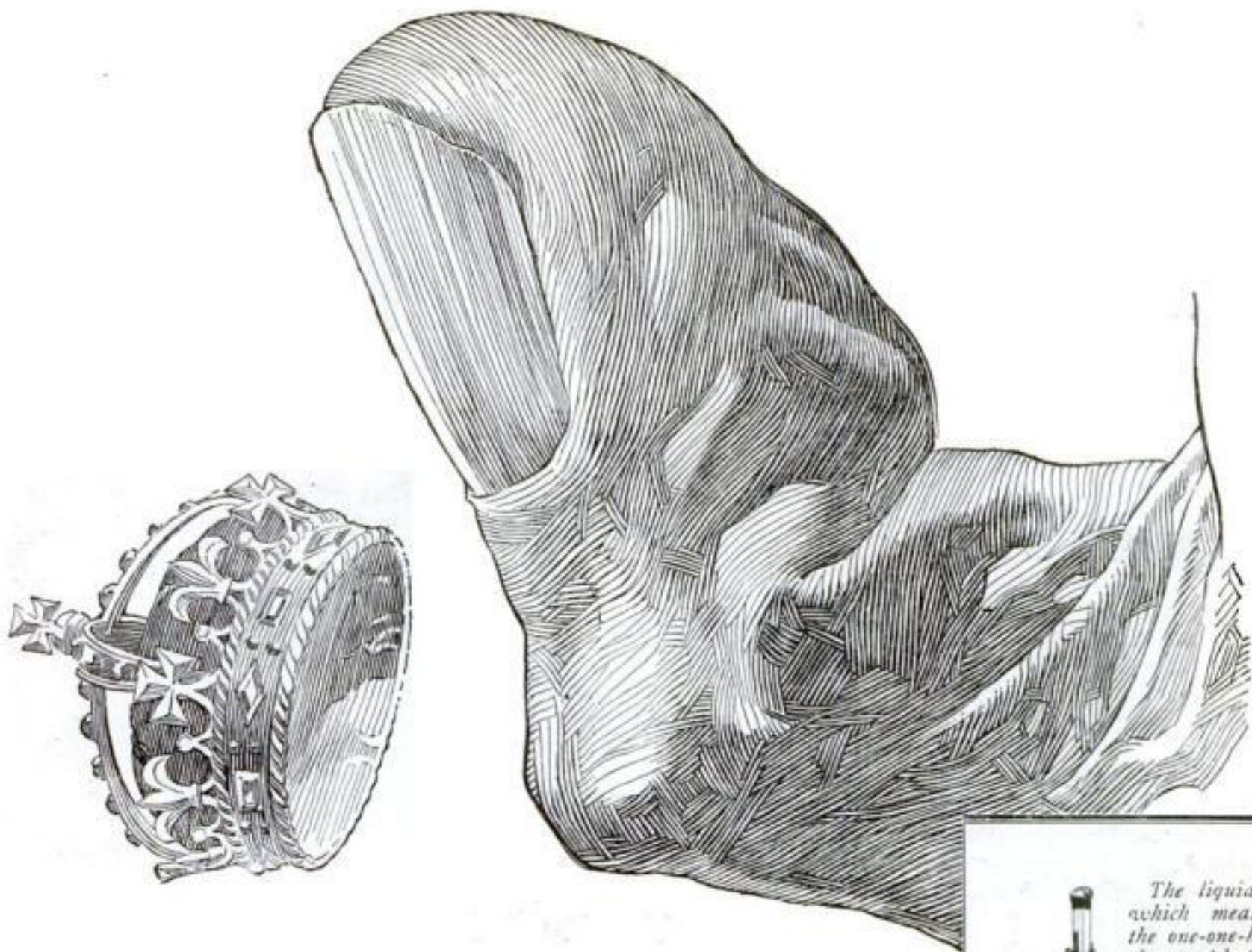
*A fine big outfit full of valuable parts for building hundreds of working models. Has a powerful, reversing electric motor and big book showing how to make over 200 models. Sent prepaid upon receipt of price if not at your dealer's.*



*Model of Windmill  
built with the new  
Multicolor Meccano*

## THE QUALITY TOY





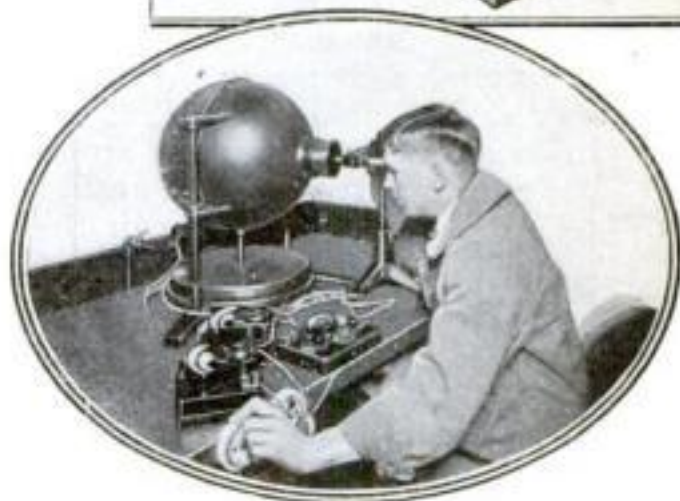
The liquid gauge, which measures to the one-one-hundred-thousandth of an inch.

## The "rule of thumb" is over...

**K**ING THUMB rules no more. The rule of thumb, with all its costly guesswork, has no place in Western Electric telephone making.

Here exact measuring standards are the rule, precise in many cases to the ten-thousandth part of an inch. And this habit of being exact controls every factory activity—in the systematic planning of the great task of telephone production, in manufacturing to known standards of quality, in constantly improving methods of work—not in haphazard experiment but by scientific attack by a group of skilled industrial engineers.

At the same time, as makers of the nation's telephones, Western Electric is meeting its responsibility by holding down the cost of telephone apparatus to a figure well below the increased cost of general commodities.



Looks like a bomb, but really a little "dark room" which permits the inspector to know exactly whether a tiny switchboard lamp comes up to the mark.



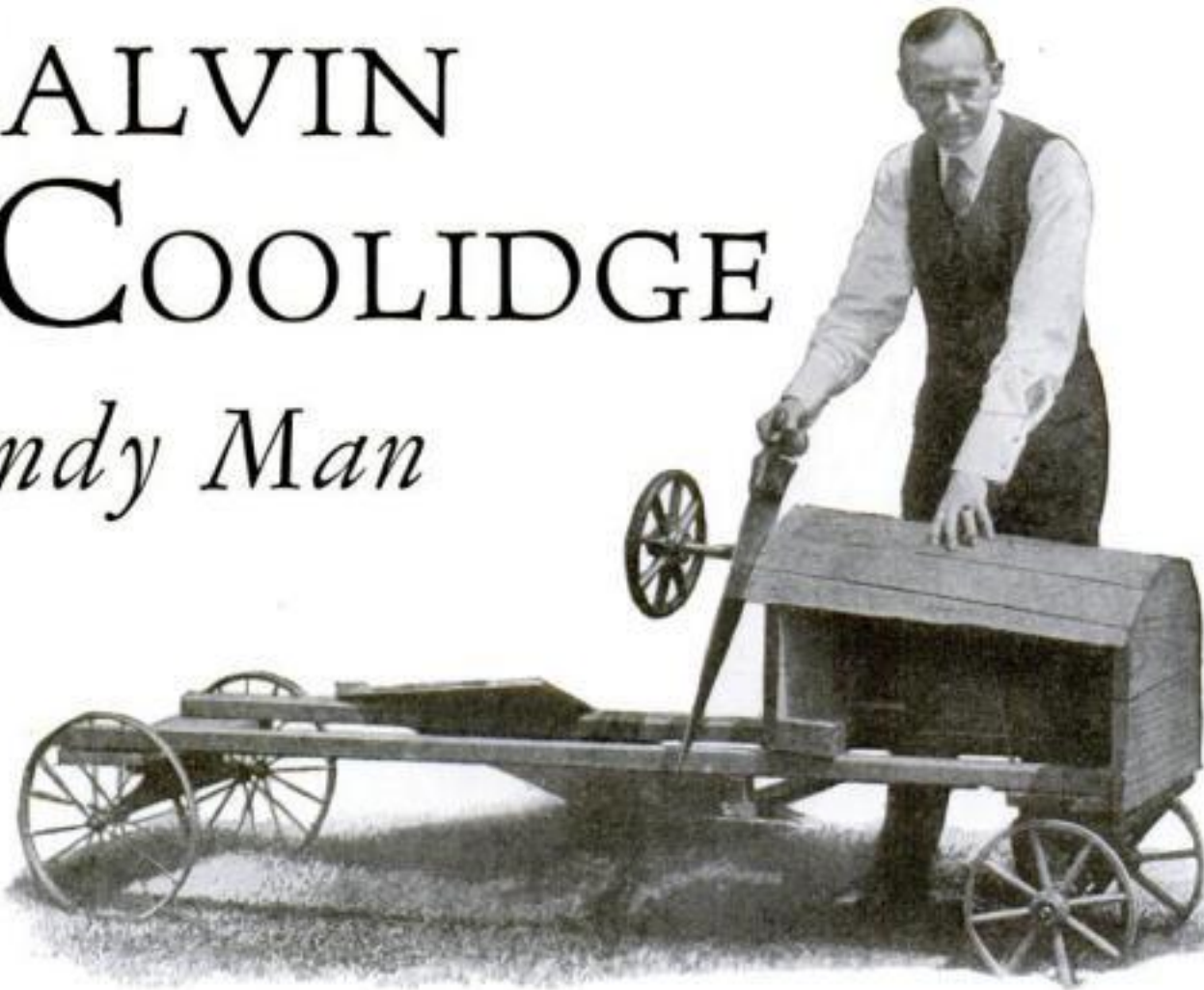
# Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM



# CALVIN COOLIDGE

## *Handy Man*



### AN EDITORIAL

**C**ALVIN COOLIDGE, President of the United States, was seated in an old-fashioned green wicker rocking chair. His felt hat was pushed comfortably back on his head. On the floor sat Bruce Barton, an old friend. They talked of this and that, as friends will. Plymouth, the little Vermont village, where Coolidges have lived for generations, was mentioned. And, according to Mr. Barton, who wrote of the chat for The Associated Press, the President said:

"Plymouth gives me something I need in my work and cannot get anywhere else. If I find a strap broken, I like to get out the tools used by shoemakers, make a waxed end and repair it. I like to do a little blacksmithing around what is left of our old shop, try my hand again with the carpenter's tools, go out and repair the fence where it is breaking down, and mend the latch on the kitchen door."

**F**OOD for thought there. The head of the biggest business institution in the world, the United States Government, finds inspiration and solace in the little tasks you and I do about our homes. He is one of a constantly growing group of American leaders who know the value of a tool chest and a home workshop in giving the human mind the rest it needs.

Calvin Coolidge, Handy Man! It is a title the President can wear with honor. Thousands of

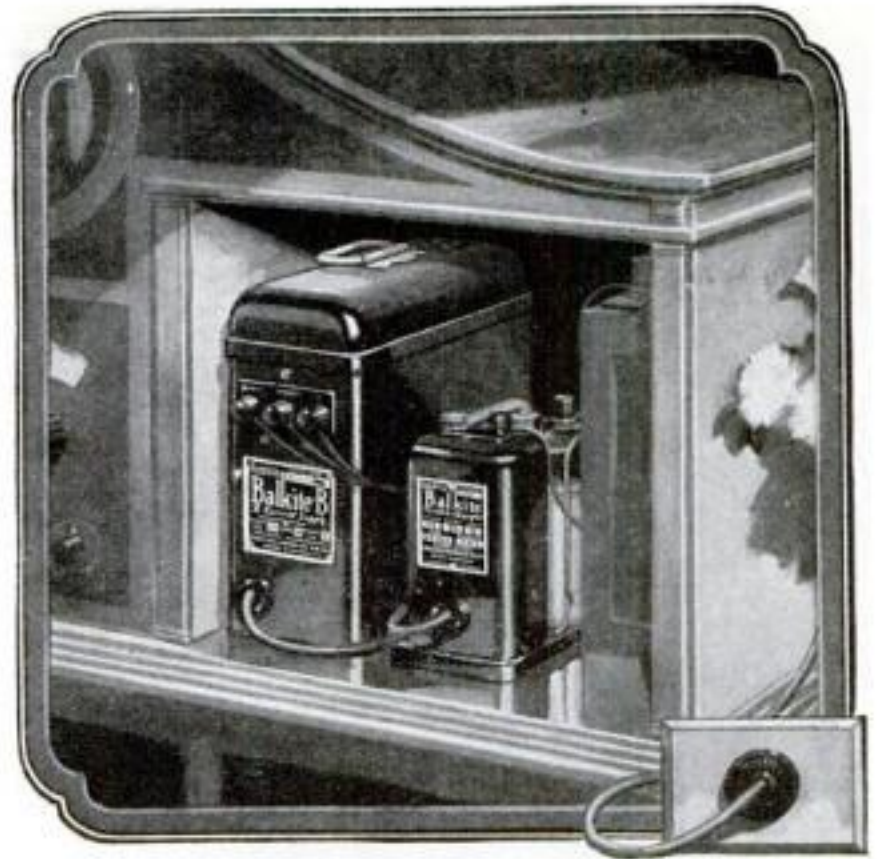
Americans, in every walk of life, wear it. Hundreds of them write to this magazine every week. My banker is building a radio set and my lawyer is shingling his house. Look about your town. You can find doctors mending leaky wash boilers, ministers making ship models and accountants building bobsleds. And each of them is doing his daily task a little better because of the stimulation he gets from his hobby.

**T**HE President is right. Plymouth gives him something he needs in his work. There is something about handicraft that brings a man closer to the kind of people who make up the backbone of the nation. The thought of the President as a handy man allies him with you and me and that father who, just before Christmas, sneaked up to his home workshop in the attic, praying that his little daughter Mary wouldn't discover him.

"And why?" asked Gilbert P. Symons, the Cincinnati clergyman who told us about him. "Doll's house! Two stories with bathroom and cupola. Glazed windows. Green and white color varnish. Real shingles made from printed linoleum. A house that Mary won't forget if she lives to be ninety. A house that is holy because that father made it with his own hands. A man that is twice a father because he is a handy man!"

I can't help but feel that perhaps Mr. Coolidge is a better President because he is a handy man.—S.N.B.





# The new Balkite "B" at \$27<sup>50</sup> and the Balkite Trickle Charger furnish all radio power from the light socket



## The New Balkite Charger

MODEL J. Has two charging rates. A low trickle charge rate and a high rate for rapid charging and heavy duty use. Can thus be used either as a trickle or as a high rate charger and combines their advantages. Noiseless. Large water capacity. Visible electrolyte level. Rates: with 6-volt battery, 2.5 and .5 amperes; with 4-volt battery, .8 and .2 amperes. Special model for 25-40 cycles. Price \$19.50. West of Rockies \$20. (In Canada \$27.50.)



## Balkite Combination

When connected to the "A" battery this new Balkite Combination Radio Power Unit supplies automatic power to both "A" and "B" circuits. Controlled by the filament switch already on your set. Entirely automatic in operation. Can be put either near the set or in a remote location. Will serve any set now using either 4 or 6-volt "A" batteries and requiring not more than 30 milliamperes at 135 volts of "B" current—practically all sets of up to 8 tubes. Price \$59.50 (In Canada \$83.)

All Balkite Radio Power Units operate from 110-120 volts AC current with models for both 60 and 50 cycles. The new Balkite Charger is also made in a special model for 25-40 cycles.

The light socket is your most convenient source of radio power. Use it by adding the new Balkite "B" and the Balkite Trickle Charger to your radio set.

Balkite "B"—the unique "B" power supply—eliminates "B" batteries entirely and supplies "B" current from the light socket. The new Balkite "B"-W at \$27.50\* serves any set of 5 tubes or less requiring 67 to 90 volts. Balkite "B"-X at \$42\* serves sets of up to 135 volts and 8 tubes. Balkite "B"-Y at \$69\* serves any standard set.

The Balkite Trickle Charger at \$10\* is probably the most popular of all chargers. Over 200,000 were purchased during one season and are now in service. Instead of operating intermittently at a high rate, it operates continuously at a low rate, thus automatically keeping the battery at full charge. In effect it converts your "A" battery into a

light socket "A" power supply. With 4-volt batteries it can be used as an intermittent charger, or as a trickle charger if a resistance is added.

Both Balkite "B" and the Balkite Trickle Charger are noiseless in operation. Both are permanent pieces of equipment, with nothing to renew or replace. Other than a slight consumption of household current, their first cost is the last. Both are built to conform with standards set by the Underwriters' Laboratories.

Over 650,000 radio sets are already Balkite equipped. Make yours a light

socket receiver too by adding these Balkite Units. Enjoy the pleasure of owning a radio set always ready to operate at its best.

\*Balkite Trickle Charger \$10.50 west of Rockies. In Canada, Trickle Charger \$15; "B"-W \$39; "B"-X \$59.50; "B"-Y \$96. Fansteel Products Co., Inc., North Chicago, Illinois.

## The Balkite Radio Symphony Concerts with WALTER DAMROSCH and the New York Symphony

These concerts will be broadcast every other Saturday Evening, beginning October 23d. On intervening Saturdays Mr. Damrosch will give a piano lecture recital alone. At 9 P. M. Eastern Standard Time, over a group of 12 stations: WEA, WEEL, WGR, WFI, WCAE, WSAI, WTAM, WWJ, WGN, WCCO, KSD, WDAF.

FANSTEEL  
**Balkite**  
Radio Power Units



**[[ The purpose of this new Department is to help Readers of POPULAR SCIENCE MONTHLY save money and invest it safely and profitably ]]**

# How HERBERT CLARK Gained Financial Independence in 15 Years

By WALLACE AMES, *Financial Editor*

**M**R. FOWLER had been President of the First National Bank from its beginning and under his direction it had grown to be a large institution. But the Bank's expansion had not changed Mr. Fowler much. His desk was still out in front where he could meet customers. He always made it a point to keep in close personal touch with them. For over thirty years Mr. Fowler had watched the progress of the Bank's depositors,—or at least the progress of some of them,—the ones who were getting ahead. He had lived a full business life close to the financial affairs of his fellow-townsmen. He knew a lot about the money problems of the average man.

It was the last business day of the year. After banking hours Mr. Fowler and the Cashier were going over the Bank's statement together. On this particular occasion a whole parade of the Bank's depositors seemed to be passing before Mr. Fowler's mind and finally his conversation drifted into an unusually interesting channel.

"DO YOU know, Fred," remarked Mr. Fowler, "I have come to the conclusion that it takes only about fifteen out of these seventy years of a man's life to settle his financial success. Whenever I look over the records of the men who carry their personal accounts here in the Bank I am impressed with the unusual importance of the comparatively short stretch of fifteen years in the average man's welfare. And often I wonder why more men, young men, middle-aged men, and even older men, do not figure out how much they can do in fifteen carefully planned years and how much easier and pleasanter everything would be for them as a result."

"To illustrate what I am driving at just take some of the men who have been calling on me today. Take the case of Herbert Clark who has just been made Vice-President of his company. Herbert came to this town right from college and started to work for \$18 a week. He is still under forty,

yet he told me today that he was worth \$53,000. He has \$8,000 equity in his house, owns \$20,000 stock in his company and \$25,000 in good bonds. He has done all that in a little over fifteen years."

## A New Service

for Readers of

POPULAR SCIENCE MONTHLY

**T**HIS new Department is to help readers in the establishment of proper financial programs at the beginning of their business careers; it assists those who have accumulated money in the proper investment of it so that it will be safe and so that it will grow.

The Editor of this Department is an authority on investment matters and he will not only every month give the readers interesting and useful information in his articles, but is also ready to aid in personal investment problems. Advice will be gladly given regarding the proper investment of funds and proper plans of saving.

Address all your inquiries to Wallace Ames, Financial Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York.

Any advertising appearing in this section will be carefully investigated by the Publisher of POPULAR SCIENCE MONTHLY. Readers can be sure that companies advertising are reliable and that they offer securities which represent sound financial investments. While investments obviously cannot be guaranteed by the Publisher, every effort will be made to insure that only advertisements of absolutely reliable companies are accepted.

"Everyone knew that Herbert Clark was going to make good," the Cashier remarked, "and I have seen him coming right along, but I did not realize he was that well off. How did he do it?"

"Well, the beginning of Clark's financial success is recorded right here in our savings department. He opened an account when he drew his first week's pay—began by saving \$5 a

week out of his \$18. And if you look up the records you will find that every year Herbert increased his weekly savings deposit. He increased it as regularly as his salary was increased. These savings were later invested in bonds. It took two years of savings and interest to get the first \$1,000 of bonds. From that time on he added at least one \$1,000 bond a year. By the time he was married eight years ago Herbert had accumulated \$10,000 in bonds. He did not save all this out of his salary; interest helped a lot.

**T**HE YEAR that Herbert was made Assistant Sales Manager he put his savings for that year into a first payment on a home. And since then he has used his bond interest to pay on the house. A year or two later his Company gave Herbert a chance to acquire some stock on easy terms and at a very good figure. So for two years he invested in the Company's stock. The stock he paid \$8,000 for is worth fully \$20,000 now. Of course this was an unusually profitable investment, but the point is that Herbert had the money to take advantage of it when the opportunity came.

"Herbert Clark told me today he had figured up that interest and dividends on his savings had amounted to over \$22,000 in the last fifteen years. His income from stock and bonds is now \$3,500 a year."

"Clark will be a rich man before long," observed the Cashier. "The money he laid by during the past fifteen years will fix him so he can take advantage of many opportunities which always come to the man with money. And he has always lived comfortably in spite of what he has saved."

**Y**ES, SIR," added Mr. Fowler, "Clark is a fine example of the man who planned his first fifteen business years in such a way that he is already independent and bids fair to become one of our wealthy men."

"Then there is Martin Wood, assistant auditor in the same Company with Clark. You remember when Martin moved here from New England. He wasn't cut out to be a big executive. But he sure is a true



## How Herbert Clark Gained Financial Independence in 15 Years

sample of New England stock. Only draws \$75 a week today, but his home is bought and paid for, he has a snug savings account for emergencies, \$10,000 life insurance paid up, 50 building and loan shares fully paid for, and he is now buying first mortgage bonds on \$50 monthly payments. He has over \$2,000 in bonds already laid away.

"Martin Wood is the type of man who will always be on a salary, and as he grows old the chances are his personal earnings will decrease. But already he is prepared for that time. His income from savings will more than offset any decline in earnings. The money he has laid away brings in over \$700 a year in interest, but none of this is spent. It goes right back into safe investments, together with \$50 a month out of Martin's salary.

"The other day I ran across a good plan for a young man. It calls for gradually increased investment, corresponding to increased earnings. This plan was put out by a house which

sells 6% mortgage bonds. Here are the figures:

"\$10 a month for 2½ years, with interest reinvested amounts to about \$325. Then \$25 a month for the next 2½ years brings the total up to over \$1,250. After that \$50 a month for 5 years increases the fund to nearly \$5,000. Finally \$100 a month for 5 years and the investor is worth practically \$12,700."

"I wish more men knew about these figures," said the Cashier. "How few men have \$12,000 after working fifteen years."

"Yes," concluded Mr. Fowler, "and how many men could accumulate that much, and more, if they only adopted a fifteen-year plan and stuck to it."

"The trouble is, few men look at the business of getting ahead in the right way. Fifteen years seems like such a long time. It is in a way. But the average man has thirty-five or forty years in which to work and gain independence. And in fifteen of these years he can put himself in very comfortable circumstances."

## Booklets Like These Helped Herbert Clark Get Ahead

THE booklets reviewed below will assist any investor to get ahead financially. You may obtain any of them, without charge from the issuing house, by writing the Financial Department of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. For convenience ask for them by number as given below.

[1] "HOW TO BUILD AN INDEPENDENT INCOME" (The F. H. Smith Company) presents a modern way of saving money, explains how first mortgage bonds may be purchased by monthly deposits, and presents tables showing results attainable by carrying out their plan for a period of years.

[2] "DIVERSIFICATION AND VIGILANCE" (A. B. Leach & Co.) presents a brief analysis of seven basic principles that assure success in the management of personal investments.

[3] "INCREASE YOUR INCOME 15% to 60%" (The Adair Realty & Trust Co.) explains how the investor can get 6½% on money now earning 4% or 5%, on guaranteed mortgage bonds.

[4] "FORTY-FOUR YEARS WITHOUT LOSS TO ANY INVESTOR" (S. W. Straus & Co.) presents the safety record of this house and describes the safeguards constituting the Straus Plan.

[5] "SAFE BONDS FOR INVESTMENT" (Halsey, Stuart & Co.) presents their current list of diversified investment offerings, with instructive investment comment.

[6] "THE MAKING OF A GOOD INVESTMENT," published by the United States Mortgage Bond Company, explains the methods employed by that firm in originating first mortgage bond issues which pay 6% with principal and inter-

est guaranteed, or 6½% without the guarantee, which is optional with the investor.

[7] "HOW TO GROW AND HARVEST DOLLARS" (H. O. Stone & Co.) describes a savings-investment plan offered by that Company, and describes how to accumulate from \$4,603.25 to \$46,032.47 by monthly investment of from \$10 to \$100.

[8] "AN INVESTMENT INSURED FOR ITS LIFETIME" (Mortgage Security Company of America) describes their plan of insured mortgage investments. Nine points of safety are explained.

[9] "RULES FOR SAFE INVESTMENTS" (Published by American Bond & Mortgage Company) explains in language that the layman can understand the important factors of safety of real estate bonds.

[10] "BUYING BONDS BY MAIL" (A. C. Allyn and Company) explains how the investor may safely and conveniently deal with an investment banker through the mails, and without the usual advantage of direct contact.

[11] "YOUR MONEY" (Fidelity Bond and Mortgage Co.) covers the points of general interest to the investor who is planning to put his money in sound mortgage bond investments.

[12] "THE SCIENCE OF FORTUNE BUILDING," published by George M. Forman & Company, is the explanation of practical, tested plans employed by investors to attain financial independence.

[13] "INVESTORS' GUIDE," published by Greencbaum Sons Investment Company, combines a description of "bank safeguarded" bonds with an outline of the service of that company.

# ST. LOUIS



## 211 Different Kinds of Industries

St. Louis has factories in 211 different kinds of business. Almost every line of manufacture is represented. Only eight percent of the city's industrial force is employed in its largest branch of industry.

This wide diversity of industries acts as a constant balance and makes St. Louis strong in times of business depression. It assures stability of labor and production.

There is a westward trend of industry. Modern business is moving toward the center of the country. This has resulted in **196 new industries** coming to St. Louis in the last six years. The central location of St. Louis makes it an economical distribution point. **Your** factory in St. Louis would have a distinct advantage over competitors not so favorably located.

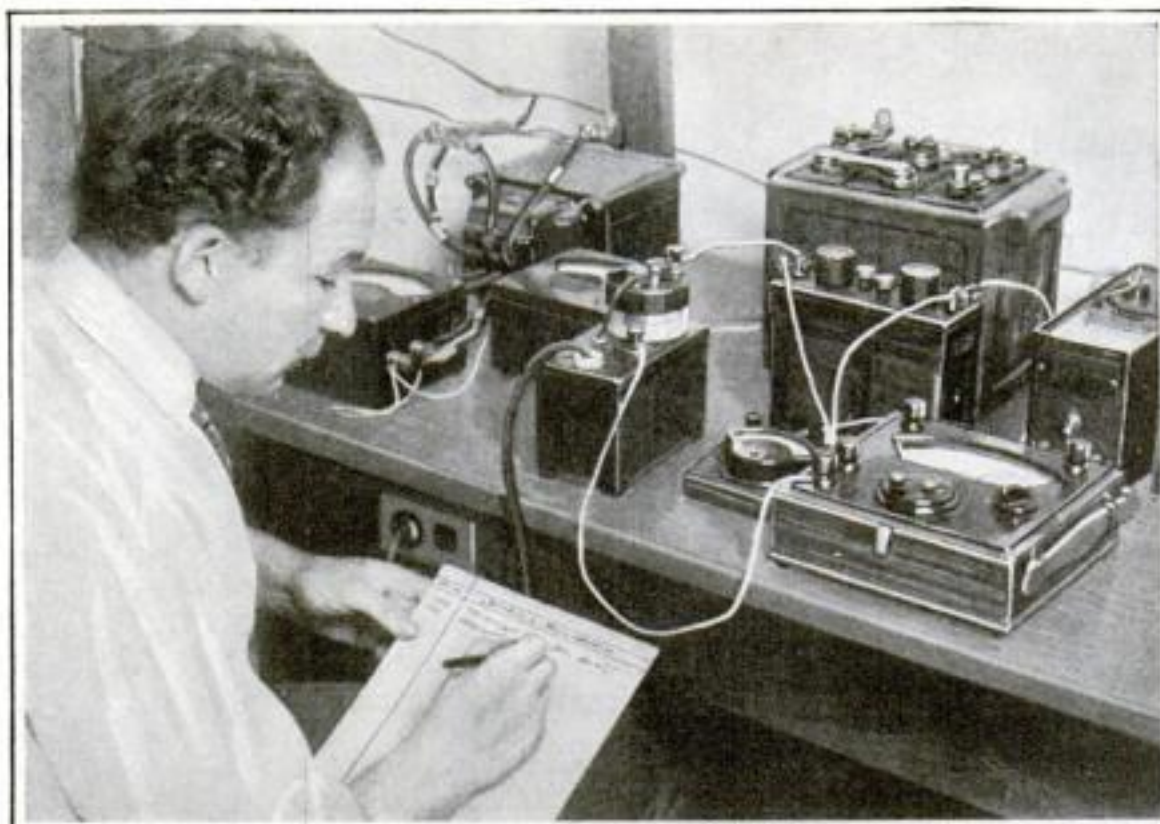
Send for our booklet  
"Why St. Louis Grows."  
It tells the full story.

Address Dept. 32

# ST. LOUIS

CHAMBER OF COMMERCE  
ST. LOUIS, U.S.A.





**T**HE EXTREMELY sensitive instruments shown in this illustration are used to determine with scientific accuracy the operating characteristics of the trickle "A" charger under test

## SOLVING YOUR A-BATTERY PROBLEMS *with a Trickle Charger*

By

COLLINS P. BLISS, M.A.

Director

*Popular Science Institute of Standards*

**I**T IS but natural that the development of radio receiving sets—in themselves capable of consistently reliable and trouble-free operation—should be followed by a concentrated attempt of manufacturers to provide the radio public with accessories that will insure the proper operation of these receivers with a minimum of replacement and attention.

For the vacuum tube plate supply, the user now has available the choice of much longer-lived dry batteries, more accurately rated and less troublesome storage B-batteries, and electric-power adapting devices that very nearly approach the ideal characteristics of batteries without requiring replacement or recharging.

The problem of obtaining an equally reliable vacuum tube filament supply seems at this time best solved by augmenting the storage battery with a continuously charging trickle charger, or with self-contained A-power devices that incorporate a low capacity storage battery with some arrangement of automatically controlled intermittent or continuous charger.

All of the trickle chargers approved by the Popular Science Institute of Standards should prove very satisfactory in insuring an ever ready A-power supply when used in conjunction with storage batteries and when connected as recommended by their respective manufacturers, because such trickle chargers have been found by Institute laboratory tests to possess—

1. *A sufficient charging rate* to provide for all normal filament current consumption. This is essential if the

battery is to be kept in fully charged and efficient condition, always—the chief reason for using a charger of the trickle type.

2. *Inherent tapering action or manual control* of charging rate to provide against excessive overcharging. As the battery becomes nearly charged, it requires less current to complete the charging and provision must be made for this either by an automatic cutting down of current when the battery reaches a certain point or by an adjustment that makes possible the controlling of the charging rate.

3. *Reasonable efficiency* to insure

economical operation. The ratio between the amount of current consumed by the charger and the amount delivered to the battery must not exceed that fixed by the Popular Science Institute as being economical.

4. *Zero or negligible leakage* when power is off to prevent discharge of battery or failure of power supply or opening connection to charger.

5. *Long life of operation elements* to insure a minimum of attention. Electrodes that are affected by the acid solution or, in the bulb type of charger, tubes that are not long-lived have been the cause of some trickle chargers being disapproved by the Institute.

6. *Substantial construction* to insure long life and ability to withstand normal abuse.

7. *Proper design* to minimize fire and electrical hazards.



### *Popular Science Monthly* GUARANTEE

The above seal on an advertisement indicates that the products referred to have been approved after test by the Popular Science Institute of Standards.

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use. Our readers in buying these products are guaranteed this satisfaction by POPULAR SCIENCE MONTHLY. THE PUBLISHERS

**T**ESTS to determine these seven all-essential points cover several weeks and require elaborate testing equipment. The trickle charger is hooked up in the regular way, according to the manufacturer's instructions. A number of very accurate instruments are then inserted into the circuit to determine both the initial operating characteristics of the charger and its behavior over the entire period of test.

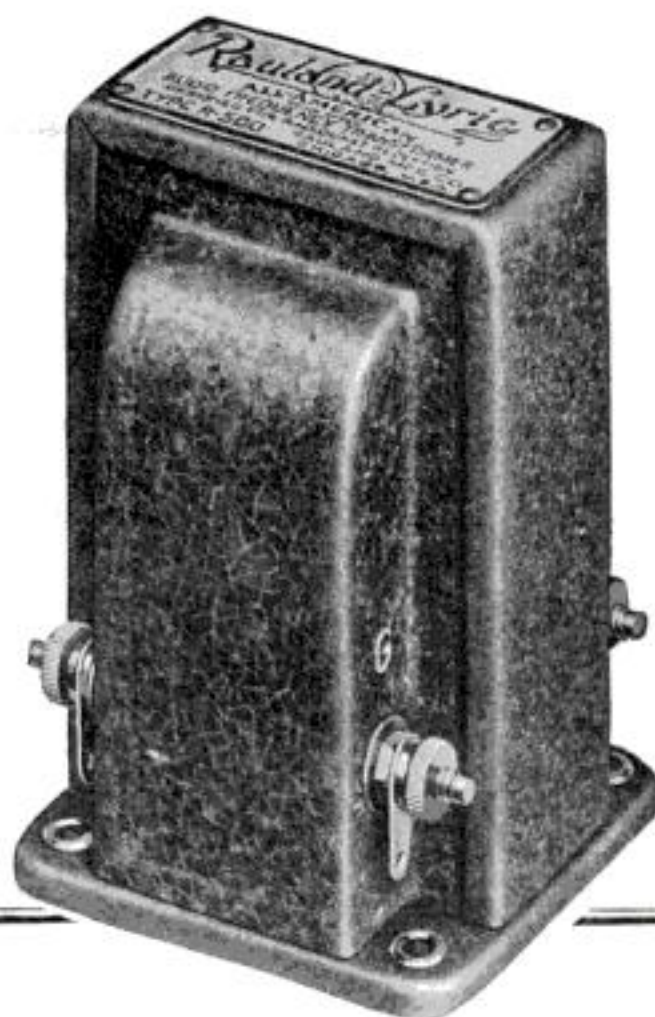
Readers who are considering investing in a trickle charger can secure a list of those approved—as well as other radio and tool equipment—by writing to the Popular Science Institute, 250 Fourth Ave., New York, N. Y.



# Still the undisputed leader

## Rauland-Lyric

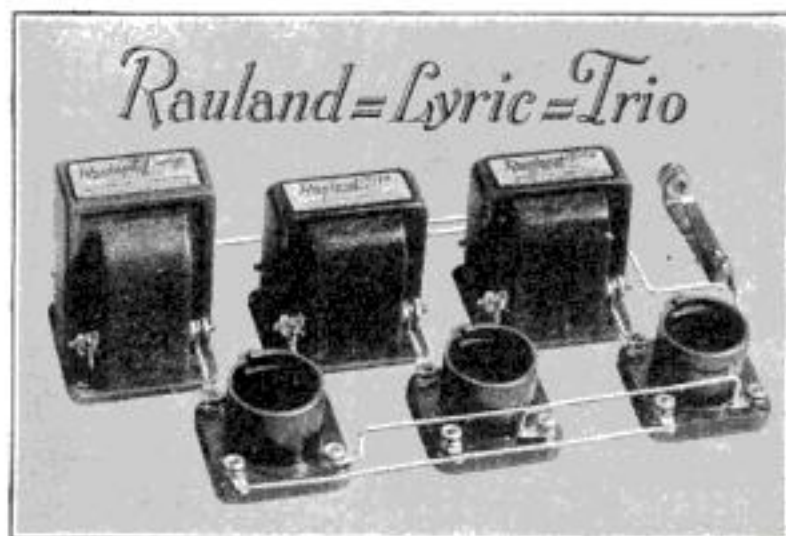
AUDIO TRANSFORMER



If you love music, and want your radio set to reproduce tones *faultlessly*, there is one audio transformer you can absolutely depend on—the famous Rauland-Lyric.

Voices and instruments alike are amplified with amazing realness by the Rauland-Lyric; with faithful amplification of those "overtones" essential to full, natural reproduction. The amplification curve of the Rauland-Lyric illustrates its outstanding superiority in tone purity.

The Rauland-Lyric is the undisputed leader in its field. It is invariably chosen by set builders who want the utmost in perfect tone quality.



Write for "Modern Audio Amplification"  
a free book, describing this fine unit.

### A new high mark in three-stage audio amplifiers

Your receiver's tone quality depends in large measure on correct audio amplification. The famous Rauland-Lyric Transformer may now be combined with two Rauland-Trios (impedance units) to form the Rauland-Lyric-Trio—the highest known perfection in three-stage audio amplification. Rauland-Trio is a compact, well-made unit—containing in one shell—inductance, resistance, and capacity in correctly balanced relation.



### New 1927 Radio Key Book

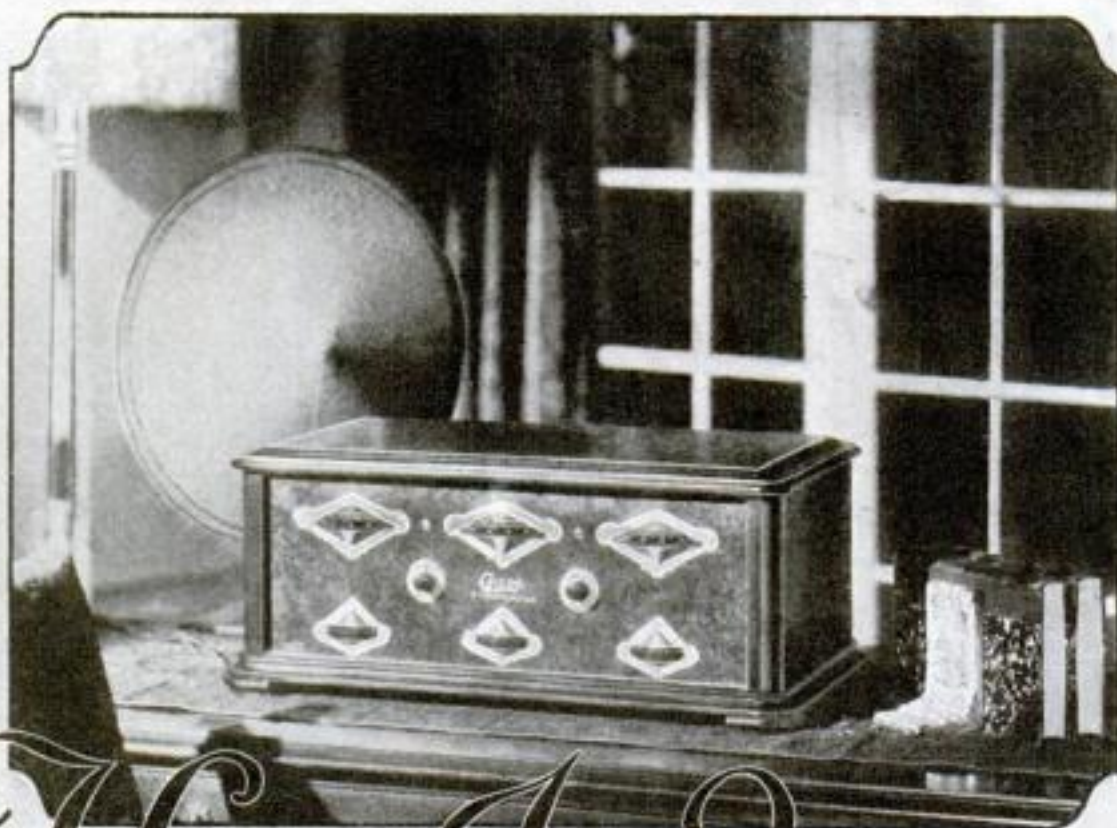
You'll enjoy reading it—48 pages of interesting, up-to-the-minute facts about radio, simply told. Also full construction details of all leading types of circuits. Send 10 cents (coin or stamps) to cover postage and mailing cost.

**ALL-AMERICAN RADIO CORPORATION**

4205 Belmont Avenue, Chicago, Illinois

OWNING AND OPERATING STATION WENR 266 METERS





The Synchrophase is also supplied with battery base and in five beautiful console models.

# Has It?

THAT ideal set you are looking for or contemplate buying—do your tests show that it has been fully developed in

- Tone Quality?*
- Extreme Selectivity?*
- Station Coverage?*
- Easy, Accurate Tuning?*
- Simplicity of Control?*
- Durable Construction?*

Test it for these qualities; then test the Synchrophase. Compare. Be exacting.

See a Grebe dealer today.

Send for Booklet P

A. H. Grebe & Co., Inc., 109 West 57th St., New York

Factory: Richmond Hill, N. Y.

Western Branch: 443 So. San Pedro St., Los Angeles, Cal.

This Company owns and operates stations WAHG and WBOQ

## THE GREBE SYNCHROPHASE

TRADE MARK REG. U.S. PAT. OFF.



All Grebe apparatus is covered by patents granted and pending.



"Make conscientiousness and sincerity your first principles."  
—Confucius.

These are the principles behind the success of the Synchrophase.

*Doctor Wm.*



Colortone  
Reg. U. S. Pat. Off.



Binocular Coils  
Reg. U. S. Pat. Off.  
and Low-wave  
Extension Circuits



S-L-F  
Condenser  
Reg. U. S. Pat. Off.





# "CAVE-IN!"

By  
EDGAR C. WHEELER

## A Stranger-Than-Fiction Story of Forty-Three Miners Who Were Rescued from Living Death

**I**T WAS noon on the fifth day of the recent Ironwood, Michigan, mine cave-in. For almost a week forty-three miners of Tom Trewartha's gang had been trapped like rats in a hole, 726 feet down. Two cave-ins—tons of boulders and dirt tumbling down the main shaft of the Oliver iron mines—had blockaded the shaft above and below them. All the resources, men and materials of the world's most famous iron mining district were concentrated on the desperate task of rescue.

In dripping blackness two thousand feet below the surface, a wiry figure in rubber coat and boots was wriggling through a narrow burrow which had been dug upward from the twenty-fourth level. The man was George Hawes of Chicago, safety expert and volunteer rescuer. At his heels were two others—Oscar Olson, chief engineer of the mine, and Capt. Gust Erickson, mine superintendent. These three were working on the daring plan of reaching the imprisoned men from the bottom upward. They had made their way into the depths of the wrecked shaft by connecting passageways from another shaft close by. Resourceful and skilful men they were, all three.

Where the mole-like burrow now opened into the main shaft was a hole through which a man's body could barely pass. Hawes, slim and agile, led the way. Squirming and twisting between jagged rocks, he forced his body through. Somewhere, a thousand feet above him in the abysmal well, lay the living tomb of the forty-three. Could he climb up through the treacherous blackness and reach them?

**W**ATER seeping from above splashed down in a cascade and drenched him. With chilled hands he clutched the rungs of a ladder that ran up one side of the shaft. The ladder was broken! By the light of his lamp he mended it with dangling cables and power lines that had been cut by falling debris. Cautiously, a foot at a time, he pulled himself upward, knowing that

at any moment a false move might start tons of rock hurtling upon him.

The other two followed. Up a hundred feet now; they had reached the seventeenth level. Only the trickle of water down the shaft broke the ghastly silence. Hawes shouted. No answer from above.

"We'll try to signal them," he said. "If they're alive they'll answer." With a miner's hammer he rapped on a water pipe that ran up through the shaft. One—two—three—seventeen blows.

"If they hear that, maybe they'll guess it means we're on the seventeenth level,"

he said. He waited. There was no reply. "Nothing to do but keep on," said Hawes. "The pipe may be broken above us. Let's go."

**A**GAIN he led the way up—as perilous a climb as ever human being attempted. Far above, the great shaft was still blocked with boulders. A single false step might dislodge enough to bury the rescuers. Now and again a break in the ladder forced a halt while they improvised rope ladders to bridge the gap.

Past the sixteenth, fifteenth, fourteenth levels, clutching and groping for a hold. The climb seemed endless. Now they approached the thirteenth.

"Look!" Olson suddenly cried. A miner's dinner pail, caught on the rocks, where it had fallen when the walls caved. It might mean anything or nothing.

Again Hawes rapped the pipe with his hammer. One—two—three—thirteen counts. A pause. Then, clearly and distinctly, a tap in reply. Another! One—two—three—four—five—six—seven—eight!

"They're alive!" he cried. "They're signaling us from the eighth level!" Again he tapped "thirteen," and again came the answering "eight."

"Thank God!" said Olson.

**S**O FAR they had climbed five hundred feet; there was another five hundred feet to go. Somehow they did it—pulling their drenched and weary bodies upward inch by inch, twisting and groping and clutching, until—

"Hello!" A voice, the light of a miner's lamp, a figure silhouetted against rock, and in another second Hawes' icy hand was seized in the iron grip of Tom Trewartha, who stood, a sentry, at the entrance to the eighth level.

"We're all safe," were the first words of Trewartha. Two miners stood beside him. "The other forty are a thousand feet back in the level, asleep."

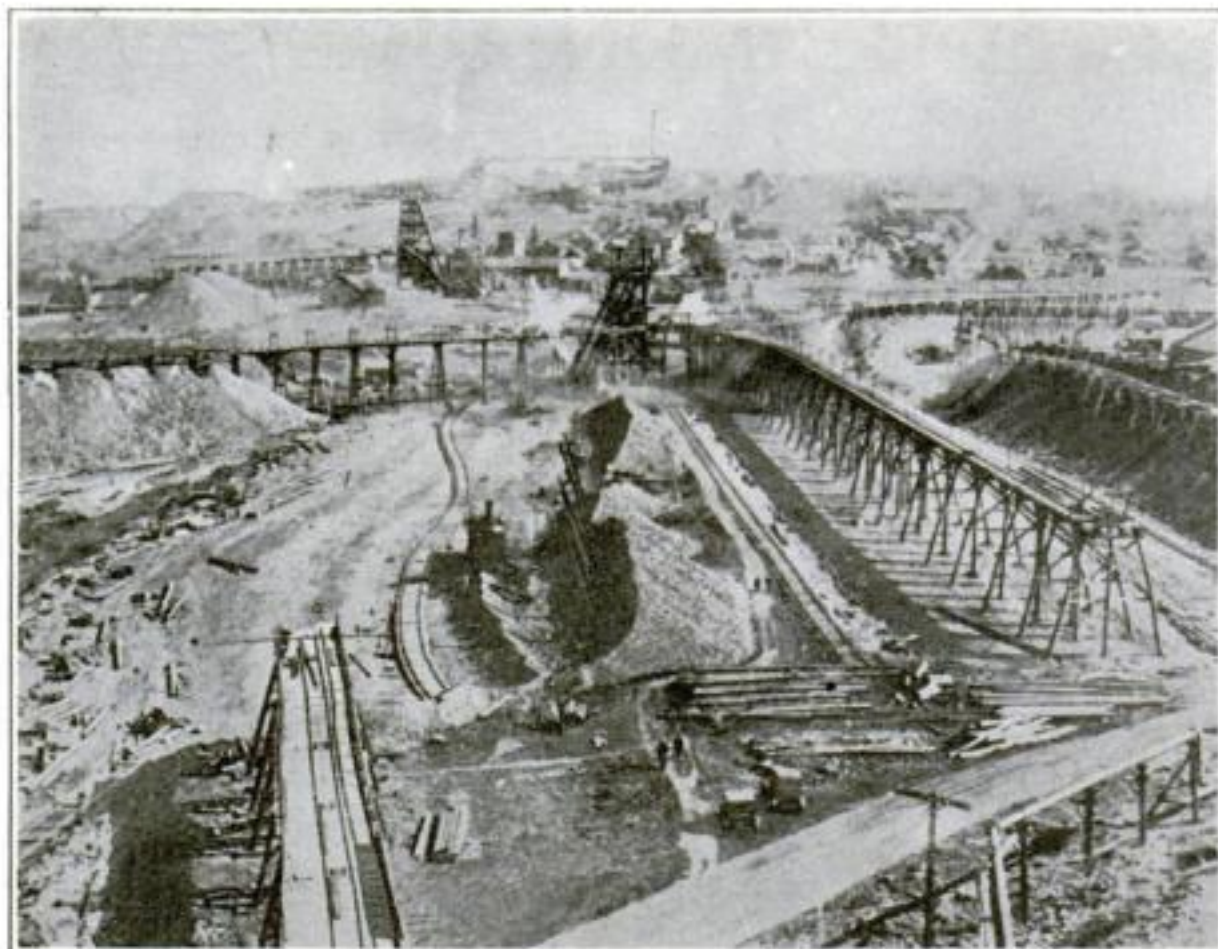
He led the way into the cavern, arousing his men with a shout. Wild with joy and relief, they crowded



After the Rescue

Dazed and haggard from the shock of their five-day entombment—some of the forty-three Ironwood, Michigan, miners as they entered the first-aid car following their miraculous escape. Once more scientific rescue methods had cheated death





Scene of the Disaster

View of Ironwood mining district. The "G" shaft, where the cave-in occurred, is in the middle distance. Beyond is the "H" shaft up which the miners escaped

about the rescuer, hugging him and pounding him on the back. They showed him about their prison and described how they had lived for five terrible days.

Trewartha, they said, had saved them from their greatest peril, the peril of despair and madness, by making them work. Drinking water they had found coursing down the mine runways. Their only food, after the scraps in their dinner pails were gone, had been birch tea made from bark peeled from timber props, brewed in a tobacco can. One man, famished, had devoured three corn-cob pipes. "The taste of tobacco was in them," he said, "and I wanted a smoke."

Luckily, for light and fuel, they had found a drum of carbide for acetylene lamps, and a five-gallon can of kerosene. For encouragement, they had listened to the distant rumblings of rescuers' blasts, to the grinding of the diamond drill, and had sung songs.

What they wanted most now was something to eat—and a smoke. Hawes fished down in his pocket and found a lone, battered cigar. He passed it around. They took turns puffing it.

**EVERYONE** recalls the thrilling rescue work that continued throughout that autumn afternoon and far into the night—how the flimsy ladders were repaired and strengthened, the emergency tunnel widened and braced; how nourishment and "smokes" were carried in to the forty-three famished prisoners; and then how, one by one, they were assisted down the perilous ladders and through winding passages to the bottom of the adjacent shaft, where they were lifted in mine cages to safety. The whole nation rejoiced with the relatives and friends who crowded about the mine entrance to cheer their men as they came from the depths.

One chapter of that story, however,

that most of us could only guess, has never been told. It was the wonderful part played by scientific and engineering genius in making possible one of the most remarkable and difficult rescues in mining history.

Here was a sudden emergency that demanded the use of every precious second. It challenged the effectiveness of scientific training in mine rescue work first undertaken nearly twenty years ago by Uncle Sam's Bureau of Mines. That the rescue was completed so thoroughly was due not only to the heroism of individuals who risked their lives, but to the fact that in the swift concentration of engineering skill not one plan miscarried.

**IF YOU** could visit one of the iron mines in the Lake Superior region and go down in a cage in one of the well-like shafts, you would realize something of the tremendous odds which faced the rescuers that Friday noon when the first alarm of the cave-in was brought to the mine engineers. You would find Ironwood, once a rough mining camp, now a city of 15,000 souls, nestled in the hills of the famous Gogebic range, for years the richest source of high grade iron ore.

About a mile beyond the unpaved ore-tinted streets of Ironwood's business center, you would come upon the Pabst mines of the Oliver Iron Company, the largest in the district.

Framework hoisting towers, rising from the hills, mark the entrances to mine shafts.

Then, if you inquired where the rescue occurred, you would be directed to the "G" shaft—the main shaft of the workings. This, like its neighbors, is simply a huge burrow dug into the hill. It goes down to a depth of 2600 feet, or nearly half a mile. Unlike an ordinary well, however, it slants at an incline of about seventy degrees. The sides of the shaft are heavily ribbed and braced with planking and steel girders to withstand the tremendous pressure of rock.

**AT INTERVALS** of about 100 feet downward there extend from the shaft horizontal passages like the branches of a tree. These are the levels.

Each level bears a number, the numbers increasing in order as the depth increases. Thus the second level is near the top of the shaft, while the twenty-sixth level is at the bottom. From each level, in turn, branch still smaller tunnels called "drifts." In these drifts the miners work, digging out the ore, which is loaded into cars and transported along the level to the shaft.

Up and down through the shaft, like the elevator in a skyscraper, runs the "cage" which carries the miners to and from their work on the various levels and which hoists the loaded skips of ore to the surface. It runs on tracks and is fastened to a cable from a hoisting engine above the surface.

On one side of the "G" shaft, about a quarter of a mile distant, another shaft of the Pabst mine pierces the earth. It is known as the "H" shaft. Some of its levels connect with corresponding levels of the "G." On the other side, at about the same distance, is a third shaft, known as the "F" shaft of the Aurora mine. Between this and the "G" shaft is an old abandoned "C" shaft of the Pabst workings. Such was the bewildering ant hill of tunnels and passages that confronted the rescuers on the day of the disaster.



George Hawes, volunteer rescuer and safety expert, who, with two others, made the perilous climb leading to the prisoners

**THE** first inkling of trouble came half an hour before the noon whistle on Friday, when the hoisting engineer at the "G" shaft became suddenly aware that the cable suspending the cage had fallen slack. Something had gone wrong. Only a few minutes before, three men, an electrician and two helpers, had gone down in that cage.

Quickly one of the skips used for hoisting ore was lowered. Before it reached the eighth level it stopped abruptly; and when the hoisting engine tried to lift it out again, the cable snapped. The skip was buried. The meaning was all too plain—a cave-in!

Instantly warnings were flashed to the miners working on the various levels below. They escaped



through the levels leading into the "H" shaft—all but forty-six. Of these, three had been hurled to probable death in the cage; the remaining forty-three were trapped in a walled dungeon of rock.

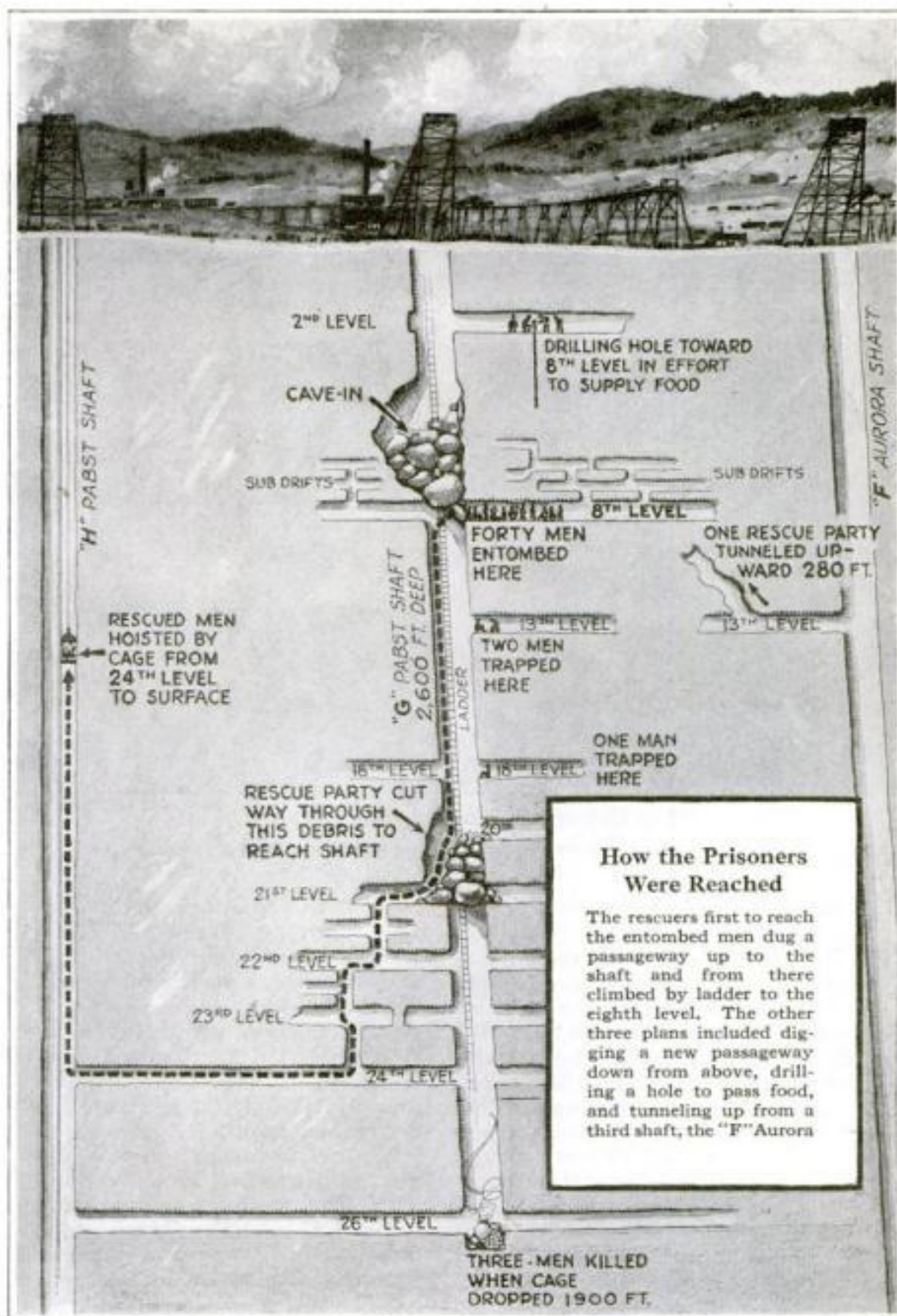
The extent of the tragedy now was revealed. Something—it might have been the effect of an earthquake months before, or of recent heavy rains, or the jarring of a derailed mine car—had dislodged a huge boulder. Tearing through the shaft wall, the great rock had plunged downward, crashing at the eighth level into the cage and breaking it loose from its cable. The cage with its human cargo had hurtled 1900 feet to the bottom of the shaft, followed by a shower of boulders. The pounding of the boulders had caused the two cave-ins, one at the eighth level, the other at the twenty-first.

**B**ETWEEN these two walls of debris were imprisoned the forty-three. Of these, forty were miners at work on the eighth level under the shift boss, Tom Trewartha. The other three were shaft inspectors, known in the mine as "road monkeys," two on the thirteenth level and one on the eighteenth.

Light wires, telephone wires and water pipes running through the shaft had been broken by the deluge. The entombed men were completely cut off from communication. Their only supply of food was what was left in their dinner pails. Trewartha was a boss of known courage and resourcefulness, with thirty-nine years of experience in the mine. He could be counted on. Yet, even with such a



"Cautiously, a foot at a time, Hawes pulled himself upward. One false move might start tons hurtling down. Only a trickle of water broke the ghastly silence. He shouted. No answer from above"



leader, how long could they hold out in the battle with hunger and madness?

It was a task that called for expert engineering and perfect teamwork. Within a few hours the entire district was transformed from an industrial enterprise into an organized army of rescue. Work in other mines ceased. More than three thousand men volunteered to risk their lives. The shift bosses lined up their men, and from them picked those who could be depended upon to stand up under the terrific punishment of driving physical labor. In all, about 300 were chosen. They were the "shock troops." Every man of them possessed working knowledge of mine engineering.

The scheme of attack was four-fold—first, to dig a new passage down through the mass of debris that blocked the shaft between the second and eighth levels; second, to drill a two-and-one-half-inch hole straight down from the second to the eighth level, through which food might be passed and communication established; third, to dig an upward tunnel, or "raise,"

from the thirteenth level of the adjacent Aurora "F" shaft to the eighth level which held the prisoners; and finally, from the depths of the "G" shaft, to bore other "raises" upward from the twenty-fourth level, paralleling the main shaft, and so pass around the lower cave-in. It was this last plan of working from the bottom up, the most difficult of all, that in the end succeeded.

**W**HILE these plans were being executed, the first rescue squads, armed with acetylene cutting torches, were hurrying to the bottom of the wrecked shaft where the cage with its three passengers had plunged. Descending by way of the "H" shaft, they groped across the twenty-sixth level until they came upon a shapeless and twisted mass of iron, half covered by dirt and rocks. No hope of any man's surviving that awful crash. With torches the rescuers cut through the tangled metal until, at midnight, they recovered the bodies of their three

(Continued on page 129)



# "It's Brains Against A Famous Big Game Hunter Capture the "Beast"

By FRANK

All Photos  
Copyright  
Ben  
Burbridge



They Captured Eight Gorillas—Alive

Ben Burbridge, noted American big game hunter, on his two last expeditions to Africa captured more live gorillas than any other naturalist—eight in all—and has brought to America the only living gorilla outside of Africa. Burbridge is shown above with the little band of Pygmy warriors who formed his hunting party

"**N**O, BWANA, we will not go with you after the gorilla. On the trail of the lion and the elephant, yes—we will follow where you lead. We will stand by you while you kill the rhinoceros and the buffalo. But the Man-of-the-Mountains is crafty. Even the lion and the elephant shun the forests where he lives. We are afraid. We will not go with you to the Mountains of the Moon."

The all but naked "headman" delivered his ultimatum. The black hunters and warriors grouped behind him nodded in confirmation.

"We will not go; we are afraid of the gorilla," they chorused.

The lean, leather-tanned white man stood up to address them. Alone, save for his train of native bearers, he had come more than two thousand miles into the heart of Africa with a single purpose. Here, on the edge of the land of the Pygmies, he was almost within sight of his goal. Eastward, towering above Lake Kivu, rose the volcanic peaks of the Kirunga mountains, and in the forests which lined their slopes lived the mysterious man-beasts, the gorillas. To study and photograph them and if possible to capture them, he had crossed the Atlantic, steamed up the Congo river to the head of navigation, then followed the equator eastward through weary weeks, only to have his *safari* balk when its members had learned his true errand.

**O**FFERS of three, six, a dozen times their regular pay for hunting trips had failed to move them. At last, by bribery and persuasion, he had induced the chief of one of the local tribes to bring his best hunters and bravest warriors before him. Now they, too, refused to go into the gorilla country.

"What are you afraid of?" the white man demanded, speaking in the Swahili tongue, which is currently understood throughout equatorial Africa whatever the tribal language may be. "What are you afraid of? The gorilla will not harm a man."

He tried to make his tone convincing. He might have succeeded with some groups of natives, but not with these. They knew better. The chief arose and came forward. Beside him limped a man who could scarcely walk.

"The white man says the gorilla will not attack men," said the chief. "Look at this man."

The lame one turned around and showed his back. Great chunks had been torn from his shoulders by the teeth of some wild beast. His knee was so twisted that he could never again straighten his leg.

"A gorilla did that," the chief explained. "This man was cutting bamboo in the forest when the Hairy-one-who-lives-in-the-hills attacked him."

**H**E TURNED and stalked away, his warriors following, back to their village of huts.

Ben Burbridge, the gorilla seeker, was not daunted by this second setback. He was too experienced a hunter, both in America and Africa, for that. For twenty-five years this retired real estate man of Jacksonville, Florida, has been chasing big game of every variety between Alaska and Mexico and all over Africa. But when the stalking of lions and elephants, Kadiak bears and jaguars, rhinos and buffalo, grizzlies and mountain lions began to be an old experience, he turned to new adventures which proved



The Only Gorilla in Captivity

Miss Congo, six-year-old gorilla brought by Burbridge from Africa, with her foster mother, Mrs. J. D. Burbridge, sister-in-law of the explorer. In this article Burbridge tells of the ingenious ruse he had to employ to separate the young gorilla from her parents

the most exciting in his whole career as a hunter,—the chase and capture of the gorilla.

**M**R. BURBRIDGE, in his two latest expeditions to Africa, not only obtained the only motion pictures ever made of the gorilla in its native haunts, but captured more live gorillas than have ever fallen prey to any other naturalist, eight in all. He succeeded in bringing three back to Europe and America alive, one of which, a female about six years old, has lived and thrived since the fall of 1925 in Florida and has furnished to scientists the first real opportunity to study the mentality of the beast which, both structurally and in reasoning powers, resembles man most closely.

In the eighty years since a missionary found the skull of a gorilla and thus partly confirmed the truth of ancient travelers' tales of a race of huge, manlike creatures who terrified their enemies by drumming upon their chests with their hands, not more than a dozen or so live specimens have ever been brought out of Africa, and only three of those were ever brought across the Atlantic to America. Most of them were tiny infants, of which only two lived more than a few days or weeks. Miss Congo, in her live-oak tree on the banks of the St. Johns River, is the only



# Brains—Fighting Gorillas!"

*Tells of Tricks He Devised to That Fights Like a Man"*

PARKER STOCKBRIDGE

living gorilla today outside of the African forests. And up to 1905 there is no record of more than one gorilla ever having been shot by a white hunter; it is possible that not more than twenty white men have ever even seen a live full grown member of this strange race.

**I**NDEED, up to a bare half century ago the very existence of the gorilla was doubted or denied by many scientific men, although the mysterious beasts were described and the name by which they are still known was given to them five hundred years before the Christian era. Hanno, a Phoenician navigator, sailed southward along the African coast about the year 500 B.C. In the record of his travels, Hanno describes a strange tribe of "hairy people" whose appearance and customs tally with what is known of the gorilla today.

Then, for more than 2,000 years, the white world heard no more of the gorilla until, in 1590, an English sailor, Andrew Battel, came home from an African voyage with the same tale Hanno had told. The gorilla was still a fanciful legend, however, until the discovery of a skull in 1846, of a complete skeleton in 1851, and of a skin, brought in to a missionary

settlement by a native in 1858.

But when Paul du Chaillu, the American explorer, published in 1861 an account of his African journey, in which he described the gorilla and its habits in detail and in the same volume told of a race of Pygmies, smallest of all humans, who lived in the forests near the gorilla country, the yarn was too fantastic to be believed. The scientists of that day might have stood for the gorilla alone, but they could not swallow the Pygmy! So du Chaillu was branded as a liar and the gorilla as a myth along with the Pygmies, until later explorers confirmed his accounts of both.

Ben Burbridge, latest of these explorers, has not only recorded the life of the Pygmies in motion pictures, but he has penetrated deeper into the thick mountain forests where the Kivu gorillas live than any white man had gone before. What he learned about the man-beasts and their way of living he has told graphically in a motion picture film entitled "Burbridge's African Gorilla Hunt," just released as this is written. And one of the things he learned is that the natives who told him gorillas would attack humans were right.

"I didn't intend to kill any gorillas," Mr. Burbridge told me, "but I did kill three, each time in self-defense as the beasts charged me. They charged many times, in fact, as I was making motion pictures of them, but usually I succeeded, with the help of my gun bearers, in frightening them off by a fusillade over their heads.

"Yes," he went on, resuming his story from the beginning, "I finally succeeded in getting a sufficient number of natives, who were not too familiar with the ways of the gorilla, to make up my *safari* into the mountains.

**W**HAT I was after was live, young gorillas. In order to hunt them at all one has to have permission from the Belgian government, since they are found hardly anywhere except in the Belgian Congo. The permit that I had authorized me to bring out four captives on each of my two expeditions, provided I gave one of each four to the Antwerp Zoological Gardens.

"Our method was to watch for a family of gorillas passing through the forest, the old male leading and the young ones straggling along behind, and to pick up the straggling infants. It was not so easy



**The Beast That Fights with Brains**

Burbridge's helper ground out this startling camera picture as the great gorilla rushed at the explorer

as it sounds, and it was decidedly unsafe if the parents missed the youngsters before we were out of harm's way.

"The gorilla fears nothing when its young are in danger. The flesh-eating beasts seem to know that, and give the gorilla forests a wide berth.

**T**HE only marauding beast which ventures into their haunts is the leopard, the stealthiest of all the cat tribe. The leopard is very fond of the flesh of baby gorillas and frequently manages to seize one and get away with it. Sometimes, however, the gorilla catches the leopard. A chief told me of hearing a commotion in the jungle one night, in which the roar of a gorilla and the scream of a leopard were mingled. In the morning he found a dead leopard, which had been literally torn to pieces.

"I had to devise many methods of exciting the curiosity or anger of the gorillas to get them to show themselves where they could be photographed, or to enable me to capture the young ones. The most successful was to imitate the snarl of a leopard, then change position rapidly when the mother gorilla charged in the direction of the sound, separating herself from her young. I would hold her attention as long as I could in that way, while my helpers snatched at the baby gorillas and scuttled away to safety with them.

"One day we caught two young gorillas in this way. We thought the rest had gone on, and had begun our march campward, when I heard the roar of a gorilla behind me. I know of nothing more terrifying than the roar of a gorilla when heard for the first time. It rivals the roar of a lion in volume, but has a more threatening tone. It is punctuated, moreover, by the beating of the beast's arms against his chest, producing *(Continued on page 132)*



**A Test of Intelligence**

Miss Congo showing the scientists that she can use her head to reach an orange—she piled the boxes up herself. Burbridge's capture of Miss Congo is giving scientists their first real opportunity to study the mentality of a gorilla





GETTING THE TRUTH in the new humane way. Dr. R. E. House, proponent of the famous "truth serum," is shown above making a truth test at Windsor, Canada. The subject is placed in a reclining position and his eyes are bandaged in order to protect them against the light, as scopolamin, the "serum" used, dilates the pupils like belladonna



RECORDING HEART PULSATIONS, the plethysmograph above betrays the emotional reactions of suspected persons when they are suddenly confronted with objects related to the crime. Its inventor, G. R. Salisbury, of Rochester, N. Y., is shown in the illustration above taking the chart from the roll at the end of a test

# Strange New *CRIME Remedies*

*A Discussion of Amazing Devices That Test Skin, Eyes and Heartbeats to Detect the Guilty and Protect the Innocent*

**A**MERICA is being disgraced by crime. The crime "wave" has become a rising flood.

Is there a remedy for this national disgrace? I believe there is, and that science can help to supply it. The remedy is more prompt and certain conviction of the criminal. Science can aid this through the methods of practical psychology that reveal the innermost workings of the human mind.

Consider, for example, the case of Andrew Toth, about which I recently read. On New Year's Day, 1891, an aged watchman, Michael Quinn, was assaulted in the mills at Braddock, Pennsylvania, and killed. Andrew Toth was arrested. While he was being examined one of the men in the room fell over a cuspidor. Toth made the mistake of laughing. The man who fell immediately declared that he identified Toth as the person who had struck Quinn. Toth was convicted and sentenced to be hanged, but this sentence was commuted to life imprisonment. In 1911 a man named Stephen Toth, not related to the Toth who was in prison, died in Australia. On his deathbed he confessed to a priest that he, not Andrew Toth, was the murderer of Quinn. Andrew was released, minus twenty years of his life.

**I** BELIEVE that a psychological examination, in the hands of experts, might have revealed much that would have helped the jury judge the credibility of the convicting witness. It at least could have established definitely whether Andrew Toth was the kind of man to be a killer.

By E. E. FREE

Psychology has made enormous strides in recent years. Tests have been devised to measure the characteristics of human beings, so that their individual traits, abilities and weaknesses become evident. The minds of liars, for example, have become better understood. These methods are being used in business and in industry. When taxicab drivers in Chicago were selected by psychological tests, the number of street accidents immediately decreased. Similar tests were used by Johnson O'Connor to select employees for the General Electric Company, and the labor turnover fell markedly.

These same psychological tests can be

used, as several remarkable recent developments have shown, to study criminals and to extract the truth from witnesses. This is a logical next step in the application of science to problems of crime. Most large police departments already possess chemical experts who test bloodstains; microscopical experts who photograph the marks on a bullet and tell what gun it came from. These achievements are notable and useful, but they deal only with circumstantial evidence. Science must now deal with the human evidence also; for the law insists, rightly enough, that human evidence always takes precedence over circumstantial.

There are two ways in which psychological science can help detect crime. One is by helping to determine when witnesses are telling the truth and when they are lying. The other is by eliminating from a list of suspected persons those for whom that particular crime would be a psychological impossibility.

**O**NE way to accomplish the first of these is by means of the much discussed "lie detectors," which show, automatically, any attempt of a witness to lie. Some of these instruments record the heartbeats of the witness. A device is attached to the witness's arm or chest. The witness then is asked questions about what he is supposed to know, or is shown objects related to the crime and which might arouse telltale emotions which the heartbeat apparatus would register. The strain and excitement of trying to lie usually causes a quickening of the heartbeats.



In the White Glare of Truth

Suspects being questioned by the "shadow box" method recently introduced in Los Angeles. They are walked onto a stage and powerful lights focused upon them so that, while they can see no one, detectives can study them as they wish while they answer questions



Another instrument, devised by Dr. W. H. Bates, an oculist of New York, measures the exact shape of the witness's eyeball from moment to moment. Dr. Bates has found that lying may create a bodily strain which tightens the muscles around the eye, and alters the shape of the eyeball. His instrument detects the alteration.

A test of guilt or innocence which the psychological criminologists have found to be even more reliable depends on another bodily reaction which apparently is absolutely beyond the control of the subject. This is the electric resistance of the skin.

**T**HE facts upon which this test is based have been known to psychologists ever since the discoveries of Dr. Charles Féré in Paris, in 1887. That savant proved that the electric resistance of the skin alters whenever the subject experiences any emotion. Many "lie detectors" and "emotion detectors" have been constructed on this principle. The most recent and successful one I know of is that devised by a New York psychologist, Dr. David Wechsler.

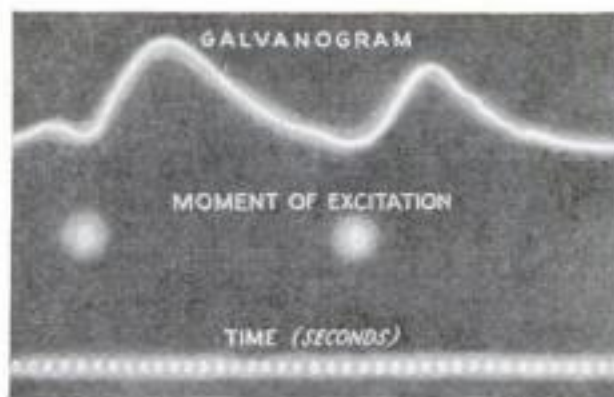
The apparatus is simple. The person to be examined dips two fingers into salty water in small porcelain jars. These provide the electric contacts. A small current, too feeble to be felt, is passed between the two jars and through the fingers. Meters connected with this circuit measure the resistance of the skin.

I sat recently in Dr. Wechsler's laboratory and dipped my own fingers into the two small cups. Dr. Wechsler adjusted the circuits and read the resistance of my skin, a figure which varies for different people and even for the same person at different times. This adjustment made, Dr. Wechsler suddenly reached over and pinched my chin. Instantly the light spot showing the reading of the galvanometer made a sharp jump across the chart.

The pinch on the chin started off an emotional reaction, composed in part of surprise and in part of reaction to the mild pain. This emotional response greatly reduced the resistance of the skin. The same thing happened when Dr. Wechsler blew an automobile horn, when he spoke of something that interested me, or even when I conjured up for myself a mental image of anything about which I was very much concerned.

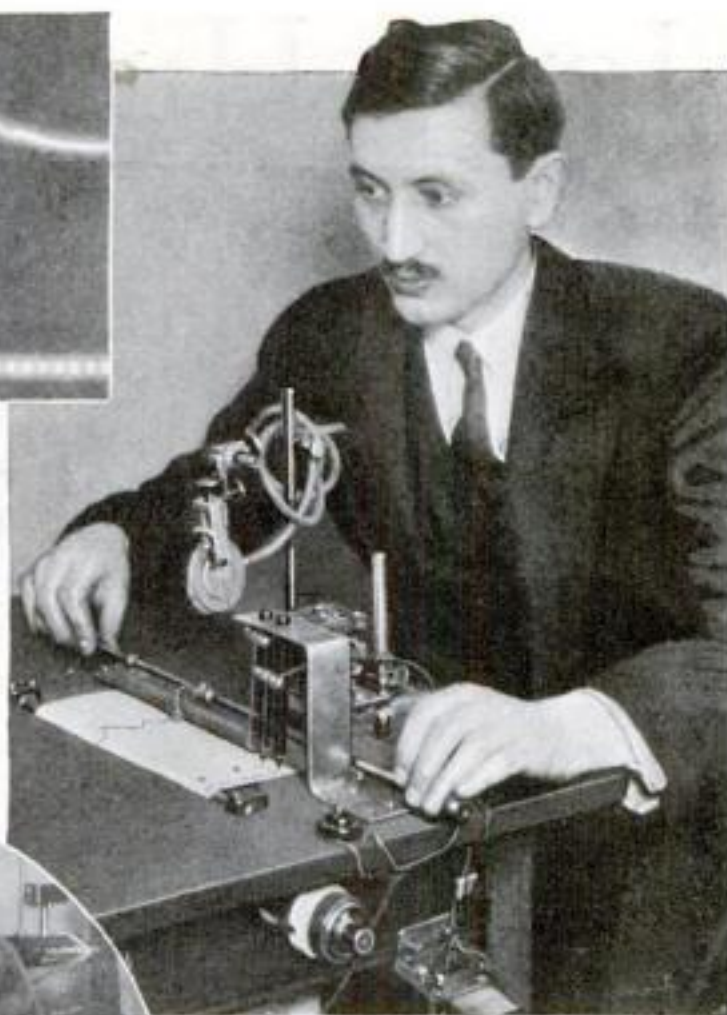
This alteration of the electrical resistance of the skin apparently is entirely independent of the will. Certainly it is so in my case, for the only effect which I produced by trying to prevent the motion of the galvanometer was to make this motion still greater and to make it happen more quickly. Certainly in most examinations of witnesses the device would provide an invaluable, and utterly unconscious, index of how fully the witness was emotionally disturbed from moment to moment during the examination.

**A**S I write this article, the State of New Jersey is in the midst of its second investigation of the famous Hall-Mills murder. Four years ago the Rev. E. W. Hall and Mrs. Eleanor Mills were found dead underneath a small apple tree outside the town of New Brunswick. Both had been shot. No one has been convicted, although the various investigations are reputed to have cost over two hundred thousand



### The Skin Test

These photographs show Dr. David Wechsler (right), New York psychologist, making a test with his apparatus, which traps liars by measuring the electrical resistance of their skin under questioning. The person tested (below) has his fingers inserted in cups of salt water. The chart above shows the result of the test, the humps indicating plainly the subject's reactions



dollars. At the moment four persons are under indictment in connection with the crime, the arrests having been made nearly four years after the murder.

Throughout the history of this famous case it has been believed by virtually everyone who has studied it that at least five persons know more than they have been willing to tell. This case would have been an excellent one in which to try some lie-detecting device like that of Dr. Wechsler. If one knew just which articles or questions were exciting and disturbing to the various witnesses, a theory of the crime would be easily found. The facts discovered psychologically might not actually solve the mystery, but they would be sure to yield valuable clues.

**T**HIS emotional disturbance, while not, of course, a sure proof of guilt, is an important clue that can be followed up like any other clue. Like other clues, to be sure, it sometimes proves fruitless; but in any event it provides a new basis on which to sift the evidence of a crime. I remember, for example, one case in which a woman witness was being examined by a lie-detecting device depending on the heartbeat. She was shown articles related to the crime. She was asked questions, all of which were passed by or answered without a quiver of the machine. Suddenly, at the sight of some article which turned out later to have nothing to do with the case at all, the indicators on the machine showed great

excitement. The truth was that a mouse had peeped out of a hole in the flooring behind the examiner. The witness saw the mouse. Her heart instantly began to misbehave.

Another procedure for eliciting the truth from unwilling or untrustworthy witnesses is the famous "truth serum" proposed a few years ago by Dr. R. E. House, a Texas physician. When a dose of this drug is given to a witness, he seems incapable of telling a lie. The truth comes out, whether the witness wills it or not.

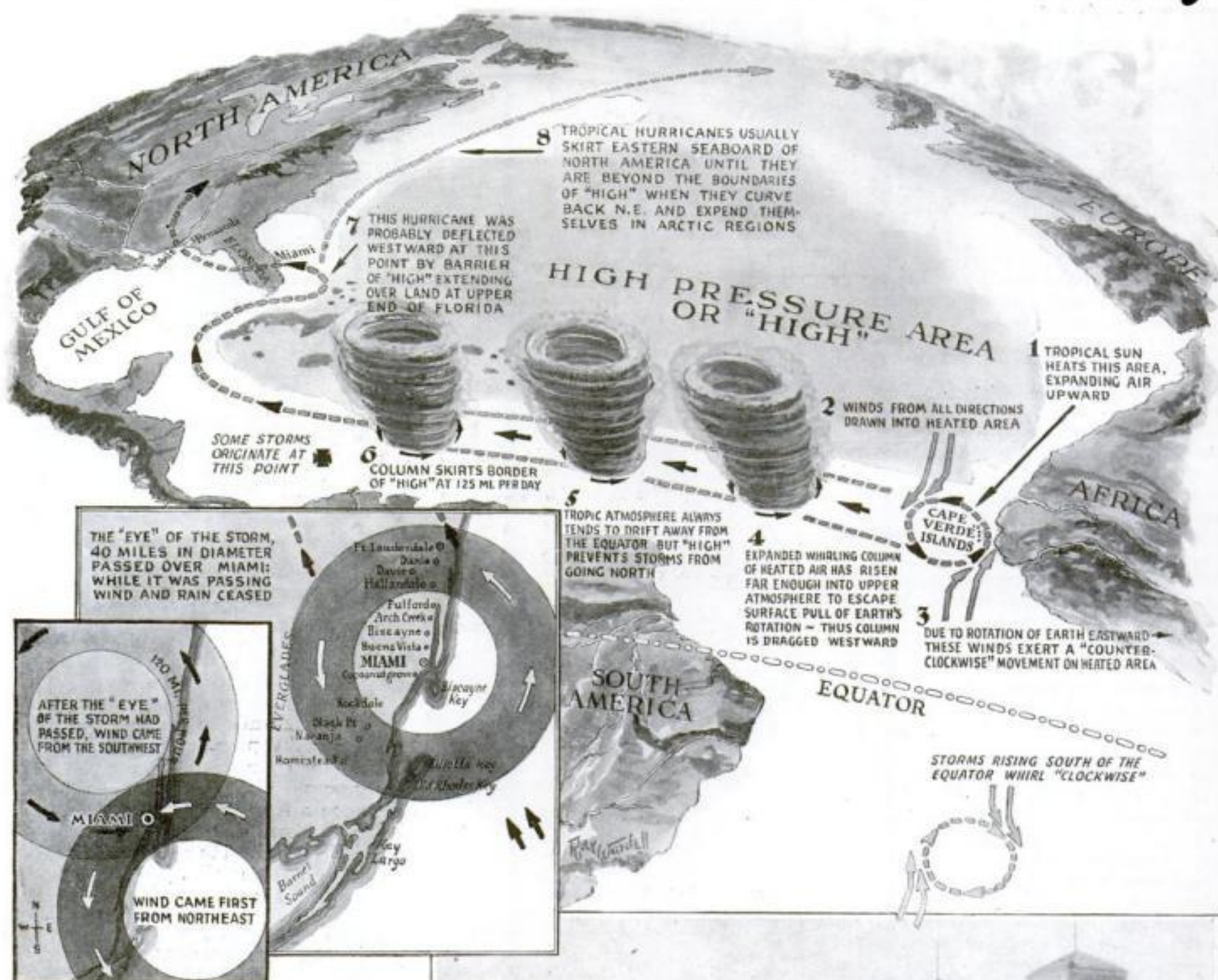
**T**HIS is not really a "serum" at all, but a well-known drug, named scopolamin, long known to physicians and used in the famous "twilight sleep" much discussed a few years ago. One of the effects of this drug on the human mind is to paralyze what psychologists call the "censor," that continual watchfulness which guards everything you say and do and sees to it that you do not blurt out, on the spur of the moment, any foolish thing that happens to come into your head. In a sense, it paralyzes the will, including the will to deceive.

In New Orleans, three newspaper reporters took doses of the drug before the city medical society. They had agreed among themselves to try to lie. But when questioned, under the influence of the drug, the lies would not come. The truth came out instead.

Of course, the three reporters were presumably men who were habitually truthful. Their natural impulses were to tell the truth. Many criminals are not like this. Either by nature or by long education and experience, lies come more easily to them than the truth. This is likely to affect their reactions to the Texas truth serum. Still, when properly used and interpreted, and especially when administered according to the careful technique worked out by Dr. House, the drug may be a most important aid to the discovery of truth. Like (Continued on page 145)



# How a Hurricane Gathers Fury



*Wind and Rain, Spinning Like Top at 100 Miles an Hour, Wreak Havoc*

FLORIDA'S recent disaster serves as a grim reminder of the ever-present danger in a country subject to hurricanes. Within the last few years extensive studies have been made of these tropical storms and on this page our artist summarizes pictorially some of our lately-acquired knowledge of hurricanes and their habits, based on the work of Charles L. Mitchell of the U. S. Weather Bureau.

The West Indian hurricane, taking its name from the center of its native region, is not the largest of storms, being midway between the mild cyclonic storm of the temperate zone and the havoc-wreaking tornado. A full-fledged hurricane is a whirling mass of wind and rain from fifty to 200 miles in diameter, spinning at the furious rate of a hundred miles an hour, with a partial vacuum in the center, and moving like a giant top creeping along a



Casino at Miami Beach, Florida, and wreckage of approach to million-dollar pier, after the recent hurricane. Stronger built buildings, experts say, lessen damage when cyclones occur

smooth table at a rate of ten or fifteen miles an hour.

It commences as a heated mass of moist, stagnant air rising by its own lightness. An incipient hurricane north of the equator will draw winds from both north and south; where the edges of these two air streams meet, a whirlpool of air is set up, rotating in the opposite direction to the hands of a clock, as will all hurricanes north of the equator.

August, September, and October are

the hurricane months. During that time conditions giving rise to hurricanes are just right in the doldrums, a region of calm air near the equator.

Since the universal equipment of vessels with radio, shipboard observers are able to keep the Weather Bureau constantly informed of the location and progress of hurricanes. Warnings are flashed to ships and the alarm is spread on land. Even a few hours' advance notice helps lessen the damage done.



# What Science Knows About Your Feet *and* Your Shoes

*Vanity and Overtaxing Are Chief Causes of Common Ills*

By JOHN AMID

**F**OUR years ago, while supervising the production of a motion picture, I stayed for several weeks at the Athletic Club in St. Paul, Minnesota. There was a fine gymnasium there, and I welcomed the opportunity of "working out" on the track for a half hour each morning. It had been years since I'd been able to do any regular athletic work, and as I started out the first morning the physical director warned, "Look out you don't overdo it!"

"Don't worry!" I told him. "Never felt better in my life!"

I felt pretty cocky. My wind was surprisingly good. My heart was sound. I found I could run almost as easily as when I was at school. Around and around the track I went. Except that my feet hurt, I seemed to be as good as ever.

When I stopped running, however, my feet kept right on hurting. When they continued to hurt all day, and kept me awake that night, and kept right on hurting the next day, I had plenty of time to realize that something was really wrong—that the physical director's warning hadn't been so foolish, after all.

Pain is the poor foot's protest against abuse. Disregard that protest too long, and the feet will quit altogether. I wish somebody had told me this before I made that run. I've paid for my ignorance ever since with pain from fallen arches. I had not been doing a great deal of walking. Pounding around the hard-padded running track put undue strain on the weakened arches of my feet, and they broke down.

When we went to war the medical examiners found that one man in every eight passed upon had fallen arches. And the "young male population" of the draft constituted the strongest class of men, physically, in the nation. Older men are far more likely to have fallen arches or other foot troubles than young men. Among women, defective feet are still more common; women are even prouder than men of having feet that are small and painful.

**S**O WE can estimate that at least one person out of every five or six in this country is definitely suffering from weak or painful feet,—in round numbers, between 20,000,000 and 25,000,000.

And how those feet do hurt! Aching feet have spoiled more lives than aching hearts.

As in my own case, undue strain is one of the chief causes of broken-down arches. The

average man, conscious of his strength and good general health, thinks he can walk when and where he likes without bad effects. Take orders from his own feet? He scouts the idea. As a

ger. They feel that no harm will come from eighteen or even thirty-six holes of their favorite game on the one day a week they get a chance to play it. As a result, instead of lowering their scores, they frequently lower their arches.

A golf professional of my acquaintance who once overtaxed his feet in this way had to play for three years in specially made kid shoes with rigidly built arches as a penalty.

Feet can be broken down by overloading—fat men please note. Even well-developed, hardened feet can be broken down by being used beyond their strength, or by long hours. Here's where policemen suffer, pounding the pavements all day or all night. Here is where clerks and salesmen and office employees suffer; for standing on the feet is almost as great a strain as walking on them. Nurses, too, know the agonies that use of the foot beyond its strength can give.

**A**UTOMOBILES have substituted hard concrete or asphalt surfaces for the uneven roads and foot paths of thirty years ago. This is another cause of modern foot troubles. Rubber heels have given some relief from the constant hammering, but it has been only partial.

A manual on foot care and correct shoe fitting, prepared for officers of the U. S. Navy and U. S. Marine Corps, says:

"The great majority of recruits received in the service for training are men who were formerly occupied in sedentary occupations, exercising little or not at all, and riding wherever possible. This universal aversion to walking is typical of the man of today who, surrounded by mechanical conveniences of all types, saves himself the effort and takes the path of least resistance. This type of man will usually have under-developed, relatively weak feet."

**I**MPROPER shoes are another cause of millions of fallen arches. The foot must not be choked to death. A shoe that fails to give room for the ball of the foot to expand, and for the toes to spread out, at least to some extent, as the weight is brought forward in walking, is an "improper shoe." A shoe that fails to distribute the weight properly in accordance with the requirements of the individual is an "improper shoe." Tight shoes, short vamps, and high heels, used to give the highly valued appearance of



## Ten Causes of Foot Trouble

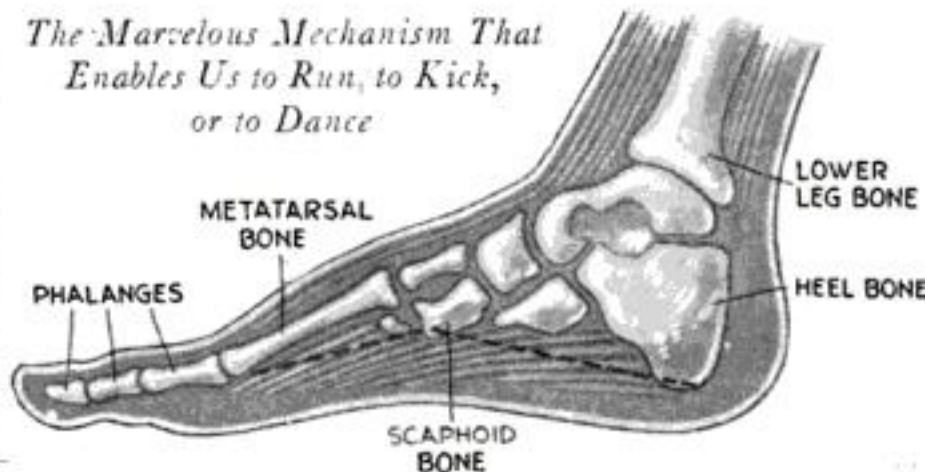
1. Sudden breakdown of foot muscles, due to unaccustomed use after long inactivity.
2. General aversion to walking.
3. Long hours of standing, as in cases of teachers, policemen and clerks.
4. Overloading—fat people seem often cursed with small feet.
5. High heels persistently worn.
6. Any illness that leaves the body in a weakened condition.
7. Local injuries that cause bad foot habits, such as turning the foot to ease a hurt toe.
8. Shoe salespeople who don't know their jobs.
9. Incorrect walking—"toeing out."
10. Vanity—which compels at least half of us to buy shoes too short and tight, to create the illusion that we have "small feet."

matter of fact, a single long walk, after months of comparative inactivity, can do serious damage to your feet through breaking down arch muscles unaccustomed to such protracted strain.

Business men who play an occasional game of golf often fall victim to this dan-

ger. They feel that no harm will come from eighteen or even thirty-six holes of their favorite game on the one day a week they get a chance to play it. As a result, instead of lowering their scores, they frequently lower their arches.

*The Marvelous Mechanism That Enables Us to Run, to Kick, or to Dance*



There are twenty-six bones in your foot, connected by four times as many ligaments and operated by many muscles and nerves. Above is the sagittal section of the foot. The lined portions indicate muscles, and the dotted line indicates the principal arch. Through misuse of your feet, the arch may begin to sag and the bones slip out of place



brevity, are usually "improper shoes." Just why the human race should become ashamed of its feet, except through neglect, it's hard to say. In China gentlewomen have bound their feet for centuries, to make them more ornamental and less useful. Never, since the days of sandals, has there been any widespread effort to strengthen and beautify the feet themselves. The tendency has been always to stress the looks of the visible shoe, and neglect the foot itself, coyly concealed within.

**T**AKE a good look at the position in which a woman's foot is held by high heels, throwing the toe downward—and the eye upward. It tends obviously to shorten the Achilles tendon, the tendon at the back of the foot, that is straight when the heel is flat on the floor. This is one of the gravest charges against high heels. Sooner or later tendon troubles are almost sure to result. Incidentally, high heels do away entirely with the long, free, healthy stride of a heelless walk.

But proud shoes are by no means limited to women. An examination of several thousand rookies at the Quantico, Virginia, Marine Station, for example, showed that four out of five were wearing shoes too short for them.

As a test some time ago, all the men in a battalion of United States infantry were allowed to select shoes for themselves.

#### Even Healthy Feet Will Benefit by This



"Toeing the bar" on the rung of a chair, to develop the pedal strength that walking should give but which, nowadays, too much riding in automobiles, street cars or buses is robbing us of

Then they were sent on a practice march. They marched eight miles, camped twenty-four hours, and returned by the same route. On the first day thirty percent, and on the last day thirty-eight percent of the men were found to have severe foot troubles.

Later, shoes were selected by army doctors for that same battalion. A march of 120 miles was made in nine days, and not a man failed to complete the trip because of foot trouble.

**A**NOTHER cause of fallen arches is found in local injuries.

A young banker whose hobby was basketball played forward on one of the teams in the local league of a New England city. One evening during the last minutes of an exciting game, the man who was guarding him slipped and fell. The banker, stumbling against his antagonist, sprained a toe. The toe didn't prove to be seriously injured, and a doctor, looking at it, said it would soon be all right. But during the following weeks, to keep the toe from hurting, the banker threw his



#### What Does Your Footprint Show?

Left, pedograph (foot imprint) of a normal foot, showing good arch and toe line. Center, flat foot; and, right, the opposite extreme of abnormally high arch, sometimes called hollow feet

weight on the inner edge of his foot, and before he realized it he was started on the way to having a turned-out foot, which specialists recognize as a forerunner of most foot troubles. A long siege with weakened feet came as a result of spraining that toe.

General disease or prolonged physical weakness may mean fallen arches that give trouble years after the disease or weakness that caused them has passed away. After such an illness as typhoid, while the whole body is still in a weakened condition, it's easy to strain the feet. Flat feet are likely to follow nervous prostration. Similarly, indigestion and fallen arches are closely allied.

**A**FTER my feet were down, I went through the miseries of the damned. At times the pain shot clear up to my hips, like acute rheumatism. Yet, the steps necessary to effect a cure were comparatively simple, if I had known them. And it was a surprisingly long time before I found anyone who did.

"Put in arch supports," recommended the first physician I went to. "That will end your troubles."

But it didn't end them at all. I put in the supports and my feet hurt worse than ever. I know now the trouble was that they didn't fit properly. They were too high for my particular trouble. Also, I know now that, even if they had given me relief, they couldn't in themselves have effected a cure.

For a time I got relief in an unusual way. I was supervising another motion picture, in the White Mountains of New Hampshire. For days together we worked above tree line, making our headquarters at the hotel on top of Mount Washington. The uneven going on the peaks necessitated constant balancing, shifting weight, jumping and all the rest that rough mountain going provides. A lot of our work was done among rocks where there was no trail at all. Though my feet protested strenuously the first few days, I was exercising muscles that needed stimulation, and they were in better condition after the two weeks in the hills than they had been for months.

But my first lasting relief from the foot pains came when I got a particular make of remedial shoe, with a low arch support that exactly fitted my foot. The

relief was almost instantaneous. I could hardly believe it possible.

To get a properly fitting shoe may sound easy—but it's not. Shoes of the canal boat order aren't necessarily the right shoes. You don't cure feet just by making them look ugly. There should be a good bearing surface, distributing the weight evenly. There should be full room for the toes. Toes are naturally playful, and like to wiggle. It's good for 'em.

In addition, there should be support for the arch—great or small according to the requirements of the individual; and support for the heel and correct position of the foot as a whole.

One of the most important points in fitting shoes correctly is that the "break" of the shoe sole should correspond with the break of the "ball points," the front corners of the foot tripod, behind the toes, in the flexion of the foot when the weight is brought forward.

**M**OST shoe manufacturers realize, far more than their customers, how important it is to fit shoes properly. Practically all stores find difficulty in securing salesmen to fit shoes correctly. And no matter how good the shoe may be or how honorable the intention of the manufacturer, placed on the wrong foot it will cause trouble.

A woman entered one of the remedial shoe salesrooms in New York City. She had a long narrow foot. The salesman showed her a "common sense" last, a little broader than her foot and with a low heel. She complained that it did not hold her foot firmly under the instep and that she preferred a higher heel. The salesman smiled wisely. He explained that the foot must have plenty of room, and that high heels almost invariably make trouble.

The customer, a little doubtful, finally accepted his judgment and walked hopefully from the store, wearing the "common sense" shoes. But instead of relief she got only more pain, in generous doses. Concluding that the first concern had done its best and failed, she tried another make of "comfort shoe" and obtained relief. In her particular case a firm, snugly fitting instep was needed to support the rather weak arch in her long foot. Also, she happened to [\(Continued on page 131\)](#)



#### To Strengthen Weak Feet—

Rise on your toes, barefoot, twenty times night and morning. Practice walking with a marble between your toes. When you sit, cross your feet for relaxation





All photos courtesy E. P. Dutton & Co.

A bull moose takes its own picture in New Brunswick, Canada—with the help of a trip-wire trap cunningly set

Raccoon nibbling at bait, setting off flash behind camera. A second camera, operated by a second flash simultaneously with the above, took this picture

# A Camera Hunter Tells His Secrets

## How You Can Trick a Squirrel into Taking Its Own Picture, or "Catch" a Woodpecker in Action

A NOTED amateur photographer, wanting some good pictures of squirrels, laid hickory nuts on rocks in a wood near his home. A gray squirrel, promptly finding them, for several days thereafter visited the rocks regularly twice a day. With that habit fixed, the photographer next attached a nut to a trip wire, twisted tightly around a groove in the nut, the wire attached to the camera so that when the squirrel should nibble, it would take its own picture.

With its first quick unsuspecting nibble, the squirrel set off the flash, and a fine picture was the result. But thereafter the photographer got no more pictures by this method. The squirrel knew what was coming, and its nervous, quick movement, when the explosion occurred, produced only a blur on the plate. Moreover, after twenty more attempts, it learned how to get the nut without causing an explosion. Each time it would timidly approach the nut, touch it with its nose, jump back as if the nut were red-hot, and then proceed expertly to free the nut without the slightest pull on the wire. Regularly, each day for a week, the squirrel came off the victor, without setting a single flash!

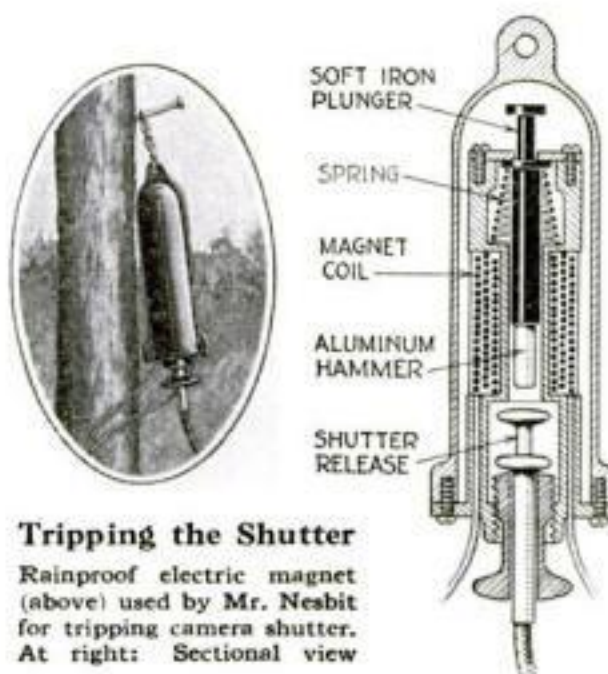
The photographer finally had to get his pictures by building a blind, concealing himself in it, and operating the flash by pressing a push button.

FASCINATING and surprising are the tales told of the always exciting, sometimes dangerous, work of the photographer whose thrill it is to trick the wild things into having their pictures taken. The inhabitants of forest and field, water and air, are less willing to face the camera than humans, and those who make outdoor photography their profession or hobby have to be more wily than their quarry. Some of the secrets of these hunters, who find the camera more exciting than the gun, have recently been told by William Nesbit, the photographer who

figured in the squirrel incident above, in his fascinating new book, *How to Hunt with the Camera*.

Many of the best animal pictures are taken with flashlight snares. Flash lamps are connected to wires stretched across a trail or baited, so that when the animal takes the bait he fires the flash powder and takes his own picture. A second camera and second flash are sometimes so placed that they will photograph upon one plate not only the flash from the first lamp, but the animal setting it off.

Anyone can set this sort of trap and



Tripping the Shutter

Rainproof electric magnet (above) used by Mr. Nesbit for tripping camera shutter. At right: Sectional view



The gray squirrel surprised into taking its picture. Then it outwitted the photographer

probably "catch" something right near his own home, says Mr. Nesbit, for more small animals roam about at night than most of us know. Skunks, raccoons, opossums, rabbits, are the commonest prowlers.

Most of these animals fall for a cheese sandwich bait. Mr. Nesbit cuts small pieces from the sides of the cheese so that the cheesecloth will be on the two outer sides when folded together. Then wire is wrapped around the sandwich, which is hung from an upright to protect it from mice. Sometimes animals are lured into the "studio" by a bait line, leading in that direction. A trail of salt or vegetables is especially enticing.

FOR an artistic background for the animal to pose against as he nibbles the cheese sandwich, branches, ferns, even rocks, are arranged. Then the camera is fixed, pointed toward the place the animal is expected to occupy—twelve feet away for a small animal, twenty for a large.

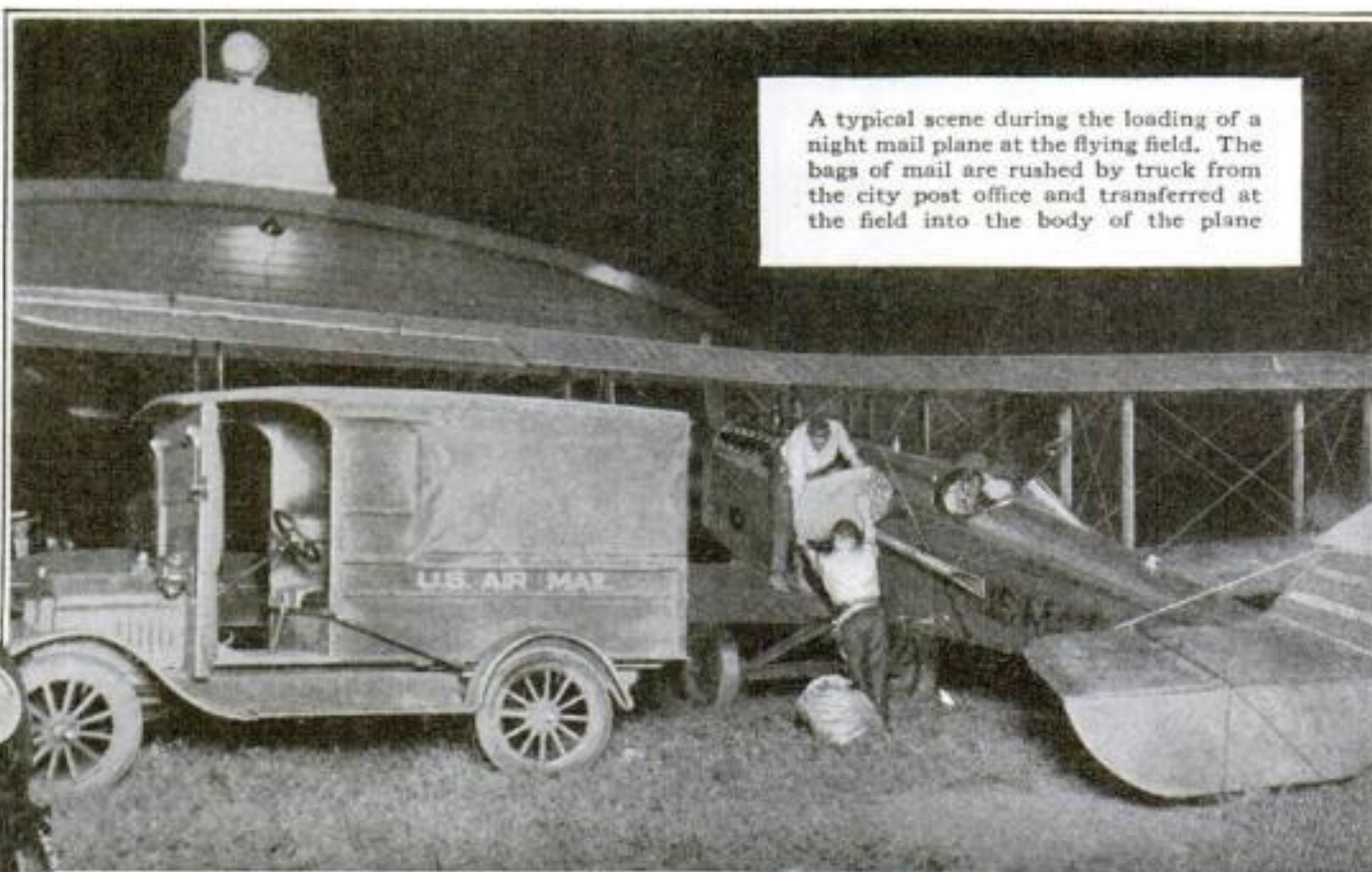
Animals, like celebrities, get used to the spotlight and come back for more. One skunk returned to the same trap five nights running, not minding the flash and bang so long as he got his sandwich. Mr. Nesbit had to break a cat of the same habit by a load of salt fired into its whiskers when the flash went off.

A sport of kings, affording tremendous thrills, is taking flashlight pictures of wild animals, especially deer and moose, from the bow of a boat at night. This is generally known as "flashlight jacking," and is done mostly in June, July and August on lakes and streams having lily pads and grasses that game come to eat.

The hunters go forth in a boat too steady to upset when the flash goes off. The darker the night the better, as the animals cannot see the boat behind the "jack." This is any lantern that throws a single beam of light forward, none striking the boat. An electric jack with rheostat handle is (Continued on page 147)



**F**OG, snow, storms and forced landings are all in the day's work for the air mail pilot. Below is Dean C. Smith, one of eight fliers who daily risk their lives on the New York-Cleveland route. He claims the distinction of being the only air mailman who ever ran down a cow



A typical scene during the loading of a night mail plane at the flying field. The bags of mail are rushed by truck from the city post office and transferred at the field into the body of the plane

## They Can Fly *with* Their EYES SHUT!

### *Thrilling Escapes of Pony Express Riders of the Air*

By H. C. NORTH

**W**ITH the morning papers of September twenty-fourth screaming out that Gene Tunney was the new heavyweight champion of the world, and with ringside photographs of the championship fight miraculously appearing in Western dailies on the worst morning-after in Dempsey's career, there was probably not one among the host of readers who gave a passing thought to the men who had risked their lives to make the appearance of those pictures possible. Yet, so hazardous was the undertaking that of all the aviators who were scheduled to fly over the Alleghenies and westward, bearing photographs of the bout, only two were able to penetrate the fog bank over the mountains and make their deliveries. They were Captain H. A. Chandler and Wesley L. Smith, air mail pilots.

Alone, his only aids the instruments on his board, his only advice his own resourcefulness, each pilot battled separately with his unyielding adversaries, the elements. Fog and rain and darkness—two hours of it without sight of earth, without a beacon or a landmark to guide them—flying blind through a fog that obscured their surroundings as completely as if a canvas had been drawn over the cockpits. Whirring dizzily through space, three thousand feet in the air, with your eyes closed!

And yet such a battle is daily life for the air mail pilots.

The mail must be delivered. Schedules

must be kept. The mail trains must be beaten. The very existence of the air mail depends on speed. Even the elements must be conquered. Uncle Sam would countenance no fair weather fliers.

It is between Hadley Field, New Brunswick, New Jersey, whence the New York air mail is shipped, and Cleveland, Ohio, that the battle has raged the hottest. And that hazardous route, beset by fogs, has been the field of the greatest victory.



Planes Have Headlights, Too

For night flying the mail planes are fitted with 250,000 candlepower headlights to insure safe landing. Here a mechanic is adjusting a headlight on one of the wings prior to leaving the field

Forced to fly on schedule time, regardless of adverse weather conditions, the Hadley Field pilots have all but perfected the science of "flying blind"; that is, navigating a plane by the use of instruments when not a single guide is visible outside the ship. After months of practice and experiment, they are now able to fly for miles, with nothing but the instruments to direct their flight, without straying seriously from the course. In carrying the mail the night of the Dempsey-Tunney bout, Captain Chandler flew blind through the fog for an hour and fifty minutes. He hit a "low curtain" four minutes out of New Brunswick, and the first earthly indication he had of his whereabouts was when he came out of the fog and saw the lights of Bloomsburg, Pa. For nearly two hours he had kept to his sky route, solely by expert use of his navigational instruments.

The near perfection of blind flying has been attained by the Hadley Field pilots only through trial and failure. It has simply been a case of master the fog or give up the route. They have learned, through strenuous experience, to fly without visibility, because they had to.

Eight pilots fly from Hadley Field to Cleveland, and their adventures, the mention of which they dismiss with a shrug, are more thrilling than ever were the Pony Express and the Western mail coach. In summer they must tilt with fog and thunderstorms; in the fall with still denser fog and more severe rain-



storms; in winter with blizzards and the accumulation of ice on the propeller, struts, fabric and wires of the airplane; and again in the spring with fog and snowstorms. Always there is engine trouble to contend with. Every season bears fresh enemies, and every day challenges the pilot to a new combat. And yet the mail is delivered and the schedules are kept.

The night of the inauguration of the air mail service between New York and Cleveland is the one that Dean Smith remembers most clearly. Large crowds had gathered to see the mail loaded, and to watch it take flight on the wings of the huge plane.

SMITH hopped into his waiting plane and was soon rapidly disappearing westward. Watchung Mountains—Cushatuck Mountain—Musconetcong Mountain—the Delaware and lights that indicated Easton; in Pennsylvania now, and going in what seemed record time: Morgan Hill—Lehigh river—Kittatiny Ridge—Tamaqua; the motor hummed steadily on; Mauch Chunk Mountains—Broad Mountains—Catawissa Mountain—lights of Sunbury—Susquehanna river—Winklebleck Mountain—Nitany Mountain—headlights of an auto gleamed on the road below—now a few scattered lights of Bellefonte, for it was getting toward morning. Next would come a beacon, then another beacon, and then a weather reporting station.

WHAT actually came instead, was a faint chug from the motor and silence save for the rush of air past the plane. The engine had gone dead!

Smith was about five hundred feet up. He used about two hundred of the distance trying to get the motor running, but it was useless. He dropped a flare and searched the surrounding country. He saw only woods and hills. Then he spied a small, smooth field. But at the end of it were a house and barns. Rather cramped quarters for a landing, but the only possible one.

As he headed downward at sixty miles an hour he knew he would crash the house, unless he "cracked up." The plane plunged madly. Ahead was the house. Slightly to the right were the barns. A few seconds more and he would be upon them.

With the ship under perfect control, Smith swung sharply to the left as he neared the ground. The left wing hooked into the earth and crumbled under. The plane pivoted about it in a huge semicircle, stood on its nose, and crashed on its back but a few yards from the house.

Smith climbed calmly and unhurt from the cockpit, and viewed the ruins of his plane. Then he approached the farmhouse and knocked. There was no reply. The farmer had slept peacefully through the whole performance. Another knock and a kick brought an ungracious reply from within. And Smith returned to his plane to start unloading his cargo.

In a few minutes the farmer, sleepy and ill natured, came out and phlegmatically

viewed the wrecked plane lying on its back.

"Do you always land like that?" he asked drily.

Smith got the mail from the ship alone, and communicated with an emergency field. A new plane was sent him, and he continued his flight. As he neared Cleveland, he ran out of gas and had to make another forced landing, this time without mishap. The mail was taken by truck to Cleveland, whence it continued its journey westward.

SMITH apparently does not consider this experience especially exciting. Hooking one wing into the ground at sixty miles an hour, and ending up beneath the wreckage of an overturned plane, he assumes to be a reasonably safe way of landing. It is his favorite method of avoiding a head-on collision.

"We are always getting into tight places and getting out of them, and that's all there is to it," he told me.

All of the pilots assume more or less the same attitude toward their experiences. Constantly facing danger, accident, and death, they consider it all a part of the day's work, what they are paid for.

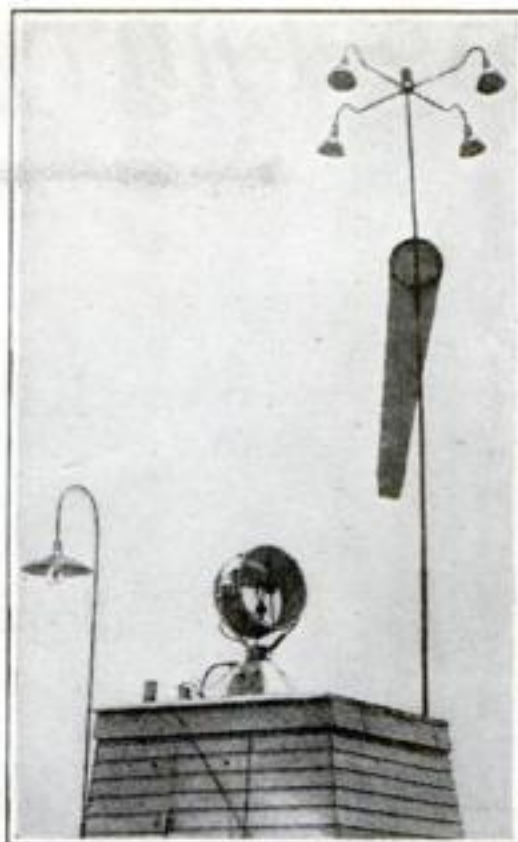
"We have thrills, excitement, close calls—of course," said one of the Hadley Field pilots, Captain H. A. Chandler. "But they are only incidental. That we reach Cleveland on time is the important thing." He called attention to the progress made in flying during the last year by citing two "incidents."

"Last year," he recalled, "I started from New York with the mail for Cleveland. When about thirty-five minutes out, I hit a fog bank. At that time we had not developed the use of our instruments nearly to the point we have today. For an hour and ten minutes I flew without the faintest conception of where I was headed, keeping to what I hoped was my course by sheer guesswork. Finally I came out of the curtain and sighted the lights of an unknown city. It might have been any city within an hour's run from Hadley Field— (Continued on page 148)



**Airway Lighthouse**

A series of beacons like this marks the route at night. Four searchlights mounted on a turntable tower fifty feet high revolve six times a minute.



**The Airman's Weather Vane**

This odd "wind cone" atop the landing field hangar tells the pilots the direction of the wind. It is illuminated from above. Notice also the five-million candlepower revolving beacon which lights the fliers into port.



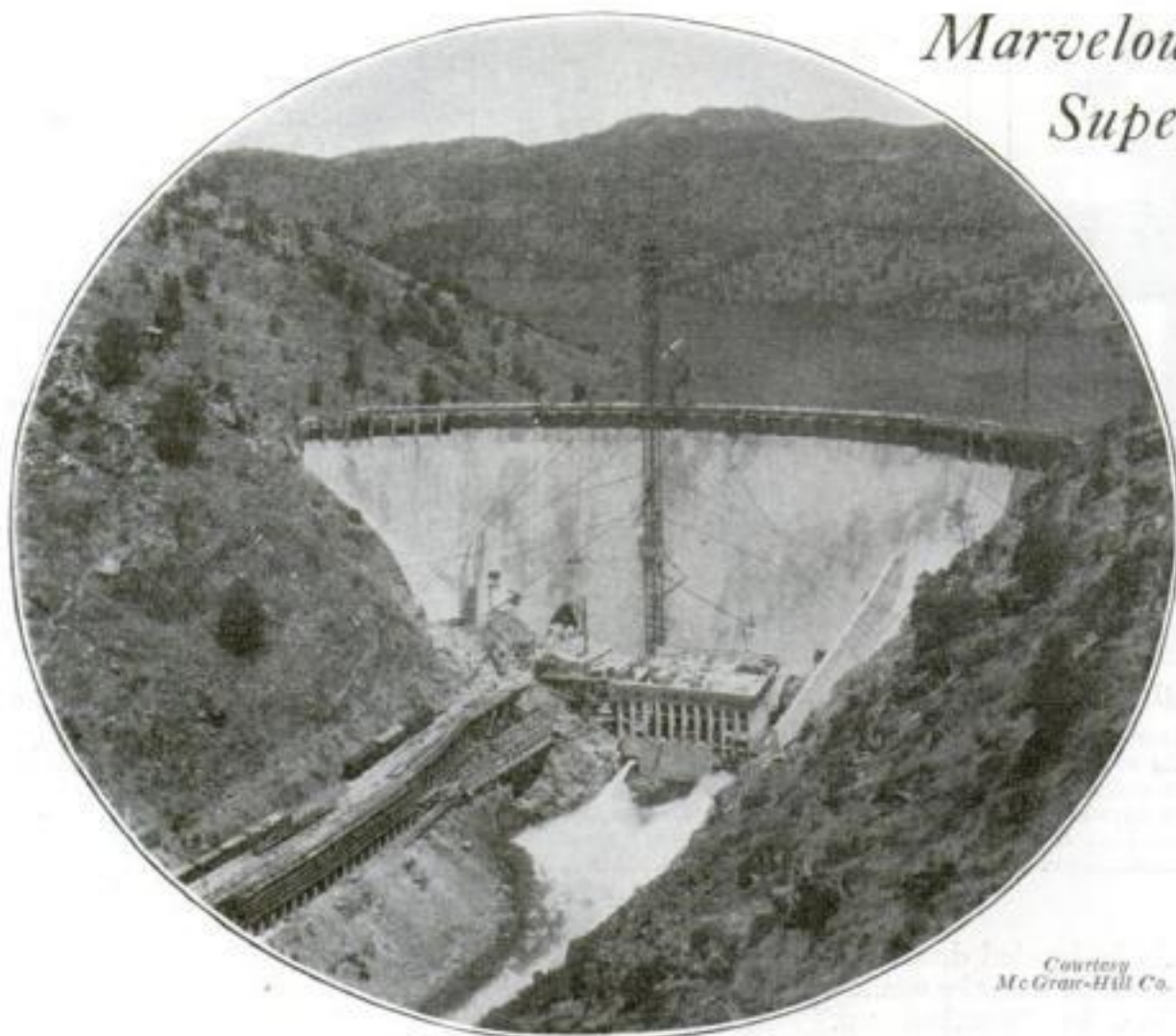
A huge portable searchlight marks out a path as bright as day to assure a safe landing. The light is mounted on a rubber-tired carriage.



# Harnessing *Thirty Million* Horses

*Marvelous New Ways in Which  
Superpower May Ease Our  
Labors and Cut Costs*

By MANUS MCFADDEN



Courtesy  
McGrath-Hill Co.

## A Future Link in a Great Power System

This is a typical power and irrigation dam, one of the many which are being constructed throughout the country and will eventually serve as links in the superpower system. The huge structure of masonry shown here, the Exchequer Dam near Los Angeles, Calif., backs up the waters of the Merced river to cover more than a thousand acres. The dam is 330 feet high and measures 955 feet along its curving crest. The mighty turbines in the power house at its base develop a capacity of 36,500 horsepower

**A** GENERATION ago the word "power" held little significance for the average man. Steam and electricity, to be sure, were commonplace, but they did not affect every individual personally.

Today, however, almost every person in the nation is an engineer in some degree and uses power at every turn. If he doesn't drive an automobile he has a radio, a vacuum cleaner, a power fan, an electrical flatiron, or any one of a dozen other necessities that depend on power for their usefulness. So great is the influence of power on our present life that, were it cut off suddenly, we would be helpless—in fact civilization would collapse. Just as the blowing out of a little electric light fuse throws a household into confusion, so would the cutting off of power throw the world back into the dark ages.

So it is with uneasiness that we read statements of eminent engineers that two of our principal sources of power—coal and oil—are limited and will be exhausted before many more generations are passed.

And then we hear promises of a new, cheap and inexhaustible power just around the corner. That power is to come from the atom. Not today nor tomorrow, perhaps, but it is to come surely. We have the word of science for that.

In his annual address as president of the American Chemical Society in Philadelphia recently, Professor James F. Norris of the Massachusetts Institute of

Technology predicted a remaking of the entire social order through the mastery of the atom by science.

"We know the atoms consist of unthinkable amounts of bound up energy," he said. "They are like a jack-in-the-box. When we learn how to touch the button the energy will spring out and we can use it."

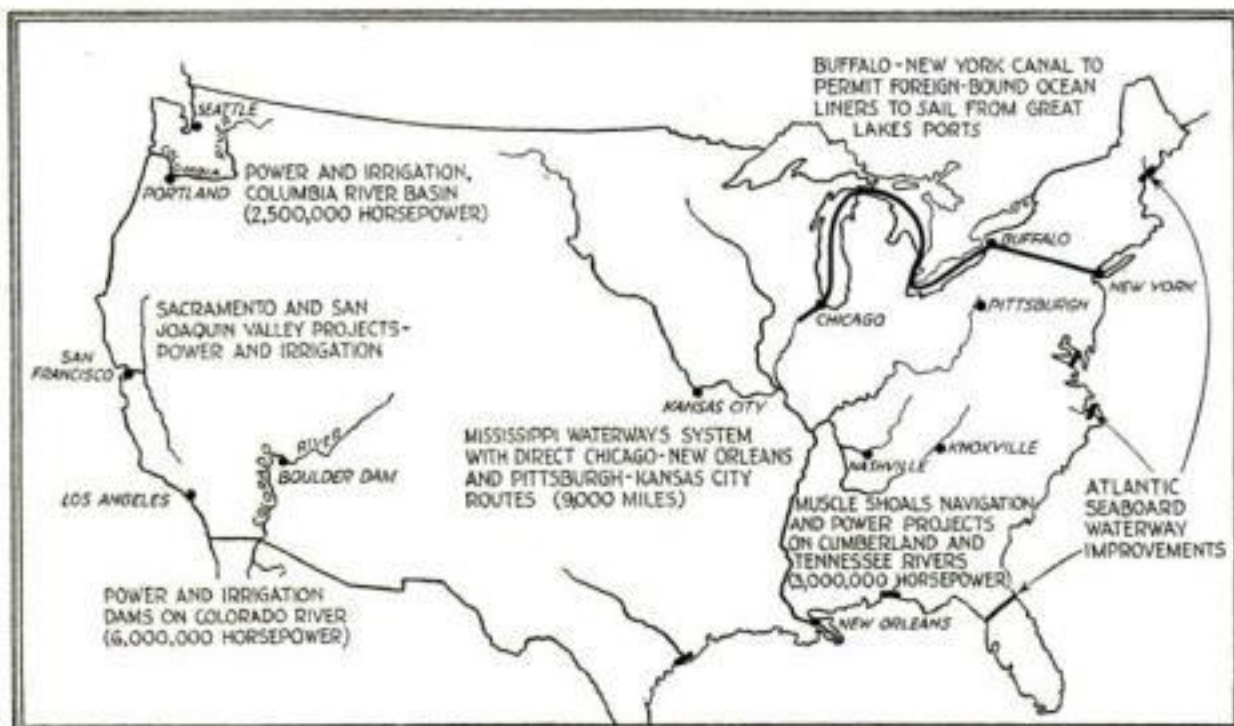
And science will learn how to touch the button. In fact it has already harnessed

the radium atom. As everyone knows, radium atoms are given to exploding. When they explode they give out power. A small fragment of radium will keep itself warm continually by the heat that its atoms generate within its mass. The amount of heat produced is many thousands of times as great as can be obtained from the same weight of coal.

**M**ANY scientists believe that similar vast amounts of power may be stored up in other kinds of atoms and might be got out, somehow, for the use of man. This project has been discussed actively at every power conference in recent years, and Professor Norris now offers hopes of its success. But there is scant possibility this will come in our generation.

In the meantime engineers are making rapid progress in utilizing the power we have at hand through the development of superpower systems. The newly coined term "superpower" has been loosely used, even in engineering circles. Shorn of all its mystery, however, it means simply the coordinated production of electric power. This is being brought about by interconnecting individual power plants, both steam and hydro.

This progress is largely due to the perfection of higher voltage transmission and to mechanical improvements in generating power. Interconnection, high-voltage lines and large units of production are vehicles and devices that make economical production possible. They are the physical structures that form a great power reservoir.



This map shows the projected or intended power and waterways projects in the United States. Engineers hope eventually to link the entire nation in a network of economical power supply



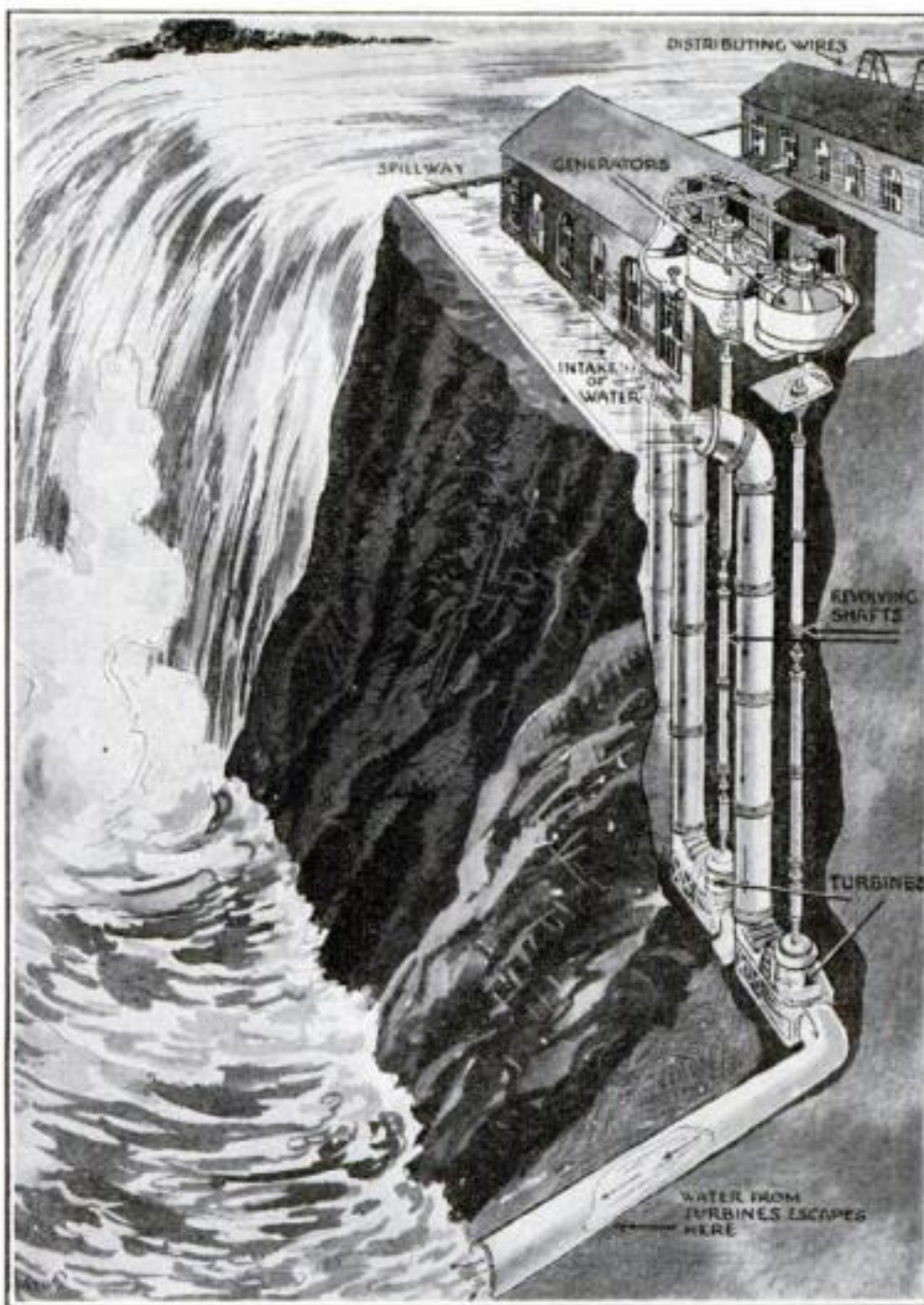
With improved transmission we can now undertake the development of the cheaper sources of power from distant waters, such as the St. Lawrence river and other streams removed from the great centers of population. Also we can look to larger steam plants situated in the coal fields, thus doing away with the expensive hauling of fuel for widely scattered power producing units.

**W**HILE the saving on freight would be considerable, there are other economies that would tend to cut deeply into the cost of power were interconnection general. For instance, isolated manufacturing plants at present are operating on an average of twenty percent of their capacity. They must have large capacity to furnish the needed power during "peak" hours and consequently they are working most of the time on "short shift." With interconnection, it has been determined, they would be working at all times at full capacity. Money invested in equipment would earn five times as much as it does now. In addition, there is the possibility of using our water powers to greater advantage. The flow of water is seasonable and the power produced varies greatly. In flood times excess power from the hydro plants could be turned into central reservoirs and steam plants could be shut down until needed again in low-water periods. The saving in coal alone would be tremendous.

Another effect of superpower would be to distribute the power load evenly at all hours. For instance, New England and New York power plants could send most of the day load to the industrial centers and most of the night load to metropolitan centers such as New York City, Boston, and other large users of night current. The result would be that, with all plants working full capacity at all hours, power would be plentiful and consequently cheaper.

**A**T PRESENT there are approximately 6,000 separate power and lighting systems in the United States. To make for the greatest economy, we need interconnection of these isolated systems over large geographical areas, so as to provide great reservoirs into which larger streams of power may be poured from steam plants and our larger water powers.

The connection of all the plants in the country in one giant system is not possible at present due to the limitation of our present-day methods of transmitting power. Power can be carried by wires up



**How Water Power Is Converted into Electricity**

Water at the head of the falls, surging into the spillway of the power plant, courses through an intake and plunges down great pipes, or penstocks, to drive a series of turbines. These, through tall shafts, are connected with electric generators at the surface, whose power is sent on its way through distributing wires. The great Niagara Falls power plants are of this type.

to 300 miles without wasteful leakage, but that is the limit so far. It can easily be seen, then, that even the great energy of Niagara Falls must be utilized at present within a comparatively restricted territory. Science, however, is lengthening our transmission lines day by day and engineers are confident they will have channels for distributing their power as fast as they are able to develop and connect producing units.

**T**HE benefits of superpower already are being illustrated in the systems of large operating companies in several parts of the country. An excellent example is the "superutilities" of California. One California company represents the merger of about 125 units which once operated independently. This system has an annual output of about two billion kilowatt hours, two thirds of which is produced by water power at a great saving of coal.

Similar conditions are found in all of the Rocky Mountain and Pacific coast states, where gigantic superpower systems are being developed.

In the Southeastern states, too, a vast network of superpower transmission lines is spreading out. It reaches from Alabama to North Carolina. New England, also, is making progress in this direction.

So far the most important superpower systems have been built up in areas where water power is abundant, but there are equal possibilities for economy in territories where steam plants are necessary.

Whether our new power comes from steam or hydro plants, or even from atoms, does not concern most of us so much as the question of how we can get cheap power and lots of it.

**T**ODAY power is produced at tremendous expense and labor. You pay your share of this expense every time you make a purchase. Your clothes, your food, your automobile, even your amusements depend on power for their production. The cost of mining coal and pumping oil are included, in some degree, in everything you buy.

With cheap power available to everyone, and a practical means of transmitting it at low cost perfected, the production of all the common necessities of life could be increased enormously, and their cost reduced correspondingly.

Take, for instance, the item of leather in shoes. This, as you know, is made from the hides of horses and cows. The animals are raised in the rural districts and their numbers depend on the amount of grazing land available. Such land is limited, even

in the Western states where the largest herds roam. But in the desert wastes of this country there is enough room to raise a hundred times as many cattle as we are now producing. It can't be done now because there is no grass in these deserts.

**W**ITH cheap power, though, water could be pumped to the deserts and they could be turned into garden spots. Already this has been done in the Imperial Valley of California, where the waters of the Colorado river have made a desert the most productive garden in the world. In the Imperial Valley it was a simple matter to tap the Colorado and distribute its life giving water over the arid soil.

It is not so simple a matter to water all our other waste places. It is feasible from an engineering point of view, but the expense of pumping water to high elevations and for long distances makes it commercially impractical. In other words, it would cost more at present to irrigate the soil than the land and its products would bring in the market.

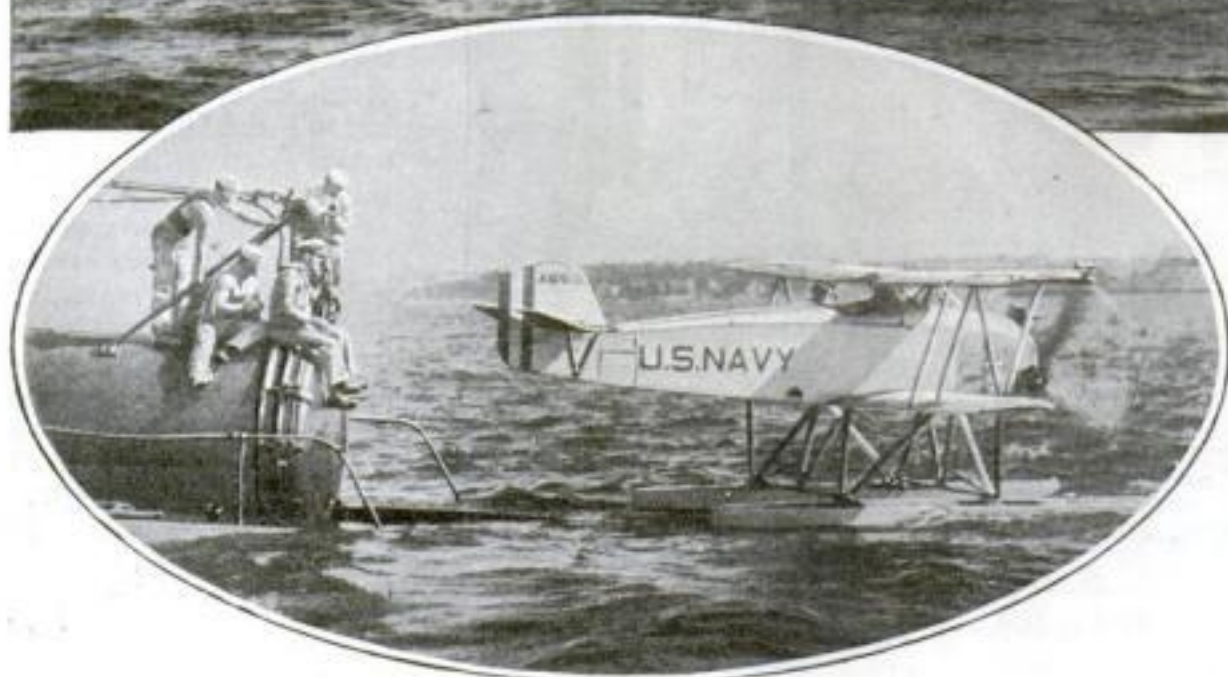
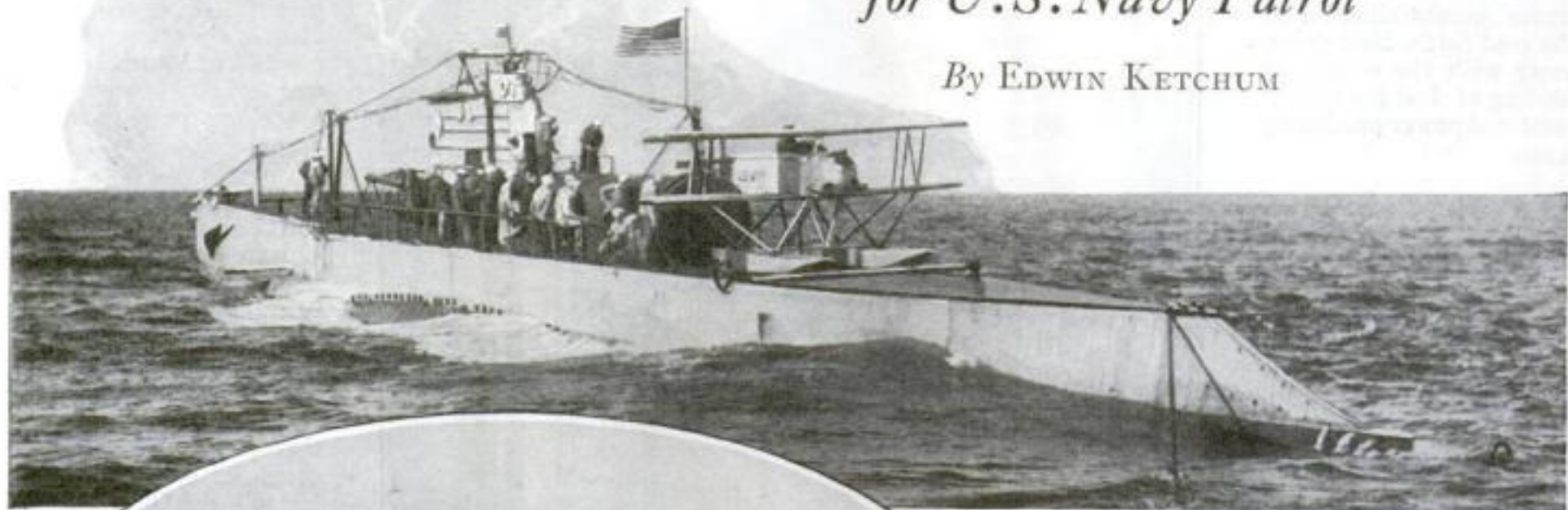
Eliminating the high cost of power, however, every square foot of dry land in the country could be irrigated at a tremendous profit. (Continued on page 150)



# Folding Plane for Submarines

*The World's First Under-Sea  
Flying Machine Designed  
for U.S. Navy Patrol*

By EDWIN KETCHUM



## How the Plane Takes-Off

Above: The tiny new submarine airplane assembled on the deck of the submarine S-1, preparatory to the launching, which is pictured at the left

minutes, ready for the take-off. At top speed it travels at 103 miles an hour.

Returning to the submarine after its flight, it floats back to the deck. Wings, propeller, landing gear and tail section are dismantled, and all are tucked snugly away again in the waterproof tank, ready for the journey under sea.

**W**HEN Uncle Sam's submarine S-1 emerged from beneath the waters of Long Island Sound near New London, Conn., a few weeks ago, it was seen to carry a strange burden on its back. The burden was in the form of a long cylindrical tank resting on the submarine's deck just aft of the conning tower.

The rear end of the cylinder opened, and from it, like a moth hatching from a cocoon, there appeared the body of a baby flying machine, a seaplane. At first it was wingless and tailless. There was no propeller at its nose, and no landing gear beneath. But quickly these, too, came out of the cocoon, and quickly they were fastened to the body. Now a sturdy little single-seater rested neatly on its pontoons on the deck of the submarine, ready for flight.

**T**HE submarine submerged until its deck sank beneath the water's surface, casting the seaplane afloat. With sixty horsepower motor roaring merrily and propeller awlirl, the little winged craft darted away, skimming the tops of the waves, then climbing into the sky.

So, successfully, was completed the first test of the

United States Navy's newest idea in fighting equipment—the submarine seaplane, designed to add aerial "eyes" to the ships that scout beneath the sea.

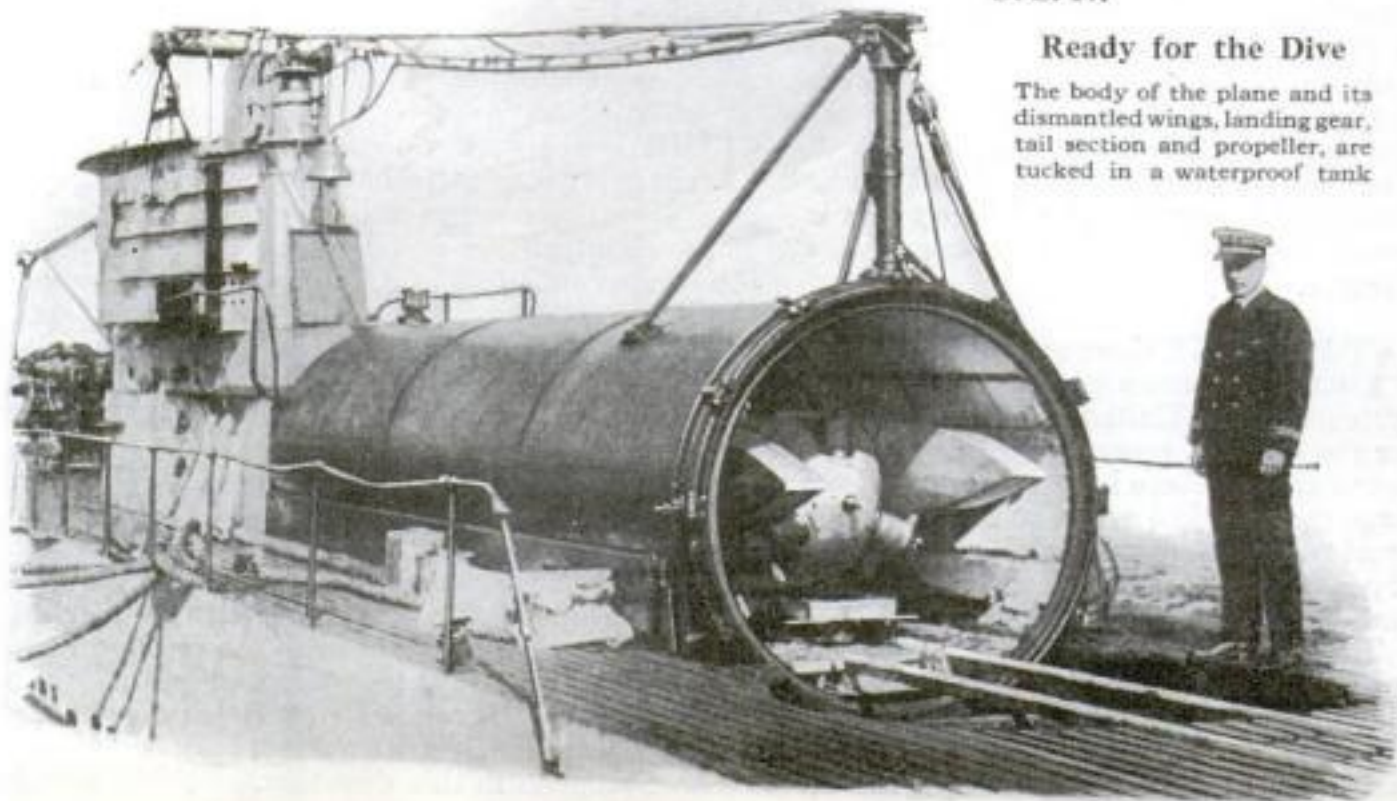
This remarkable midget plane that can travel under water was designed under the supervision of the Bureau of Aeronautics. Weighing only 1,000 pounds, it can be taken out of its shell and assembled in nine

**T**HE idea of launching scouting airplanes from the decks of warships is not new; all the great navies have adopted the practice with varying degrees of success. This, however, is the first time it has ever been applied successfully to under-water craft. Navy officials declare that it will give the submarine an effective patrol range far greater than ever was possible before.

The proud pilot of this wonderful little water bird is the first submarine airplane pilot in the world, Lieut. Adolph C. Allen, U. S. N.

## Ready for the Dive

The body of the plane and its dismantled wings, landing gear, tail section and propeller, are tucked in a waterproof tank





# The New Wonders of the SEA

*Strange Fishes Climb Trees; Carry Searchlights and Saws*

By ROBERT E. MARTIN



## An Ocean Heavyweight

This Grouper, or Jewfish, weighing 200 pounds, is one of the biggest and ugliest of all finned creatures. Its mouth is big enough for an aquarium

**G**REATEST wonderland of all is the sea. That sounds paradoxical, but in the dark, unexplored depths are more marvels yet unknown than are on land. When every other field of nature is explored, there will still be new things on the bottom of the sea.

The biggest deep-sea fishes, for instance, may be still unknown to science. They may be monsters. Thus far only small dredges have been used. No man can tell what strange creatures improved dredging methods will bring forth.

What is known now of the sea's marvels only whets curiosity. There are fishes with swords and saws, fishes with knives, with wings and with lights. There are great sharks and whales, as well as tiny animals of whom it takes forty million to fill a small net. Every scientist who goes hunting in the deep sea, if only 200 miles from the coast of the United States, brings back some new creature. The ocean teems with life.

The field is vast, for the ocean covers three fourths the surface of the globe, and is hundreds of millions of years old. It covers an area of 139,000,000 square miles. Even its water is wonderful, for what we call the "salt seas" hold gold, copper and iron, sodium chlorate and other minerals. Their tides, strangely controlled by moon and sun, are a source of power yet unutilized.

What are the greatest wonders of the sea? Ask Dr. Charles H. Townsend,



## Of Ancient Ancestry

These mudfish burrow in mud along the shore. They are descended from one of the earliest forms of fish life, which existed ages ago

## Lighted Windows

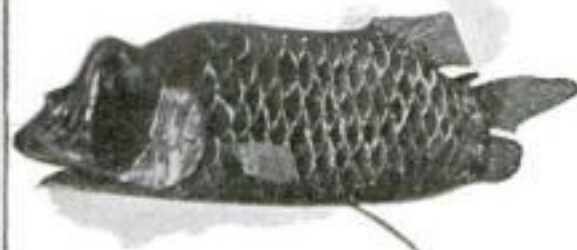
With rows of lighted "portholes" lining its wriggly sides, the *Stylophthalmus* winds like a lighted railway train through the inky blackness two miles and more beneath the ocean's surface. Its eyes are at the ends of two long stalks sticking from its head like two lamps

Director of the Aquarium in New York City, and you will hear some strange and interesting things.

"What makes the public wonder most, and what is most wonderful, are not always the same," he will tell you. "People who come to the Aquarium are most interested in the little sea horse that climbs trees. He is among the few fishes with grasping tails. Like a monkey, he uses the tail to cling to seaweed and other marine objects. We have a little tree in his tank for him to climb on, and he likes it. This 'hippocampus' is only

## The Leopard of the Deep

The eel-like body of the spotted moray is peppered with innumerable dark spots on a whitish background. Its habitat is in the tropical Atlantic Ocean



## Glow in the Dark

The *Opisthoproctus* is one of the oddest of luminous fishes. Notice how the light shines between the heavy scales of its armor—one of the marvels of the sea

six inches long, and is shaped like a question mark, with a horselike head. When he dies we varnish him, mount him on a glass paper weight, and sell him at profit enough to keep the tank full of live specimens.

**O**UR sightseers like little things and big things. After the sea horse, they like to look at the 200-pound Grouper, one of the biggest of fishes, called Jewfish in the books. They like to watch the shark swimming about with some 'shark suckers' fastened to his under side. These suckers attach themselves by air suction disks, like vacuum cleaners, on their heads. They are bluish fishes, shaped somewhat like the shark, though of course much smaller, and are 'commensals,' meaning that they eat with the shark. They take the scraps that fall from his table. The suction disks are among nature's most remarkable appliances.

"Probably, though, the greatest all-around wonder of the sea is the common eel. We have found out recently what a marvelous creature it is. Here is a fish that looks like a snake, attends an annual League of Nations meeting in a certain spot in the Atlantic, can climb the Alps, does not have children until it gets old—and when it does, dies.

"The life history of the eel, which has mystified men of science since Aristotle, has been solved only recently. The eel starts out as *Leptocephalus*, a larval form with gleaming eyes, thin as blotting paper and so transparent that you can read a newspaper through it. It is hatched from eggs laid in the Atlantic south of Bermuda. How the eggs get there is one of nature's strangest, newest stories.

"The newly born *Leptocephali* separate and form two great streams or currents, each swimming slowly to the home of its





parents. The American *Leptocephalus* turns westward, and after a year, reaches the American coast. The European species turns eastward and takes two years to reach the streams whence the parents descended to the sea. Swimming upstream, against the current, they go as far inland as the borders of Switzerland.

"The female eels go to the headwaters, males not above tidal waters. After the females have passed years inland, they decide the time has come to have a family. So, moved by this instinct which may be coupled with a premonition of coming death, they start for the annual eels' League of Nations meeting in the Sargasso Sea. In its warm waters, male and female eels from America and Europe meet. There is nothing quite like it in nature. When the two great streams of *Leptocephali* start for America and Europe as messengers from this meeting, the parents, having fulfilled their destiny, die."

**B**UT to return to what the public likes—big things. Dr. Townsend thinks the public may not be so far off, after all, because three big creatures are certainly among the most wonderful things in the sea. They are our childhood friends, the whale, the shark, and the swordfish.

Consider the whale. Little more than seventy-five years ago he lighted the world, and built up a good slice of New England. At one time there were no fewer than 700 ships in the American whaling fleet. Until more recently, the whale supplied the whalebone for women's corsets, and for the whips when they went buggy riding. He supplied food and fertilizer. Is it strange that he is very scarce today, and that some kinds of whales are in danger of extermination? He is the largest animal of land or sea, sometimes seventy feet long, vastly heavier than the heaviest of elephants.

**T**HE hammerhead shark has one of the most extraordinary formations among fishes. It has a flat head, with arms or wings—too broad to be called horns—extending outward, with its eyes at the ends. It grows about fifteen feet long in tropical waters, and baby hammerheads a foot long have been caught off Sandy Hook. Dr. Townsend does not agree with William Beebe, the famous marine explorer, that sharks are harmless, and says he has many records of the killing of human beings, mostly in tropical seas.

The swordfish really uses his sword—a pointed nose more than a yard long—mainly as a club to stun fishes. He darts among a school of small fry, and literally clubs them into submission. Familiar notions to the contrary, he does not ram

his sword into whales, though he has been known, in desperation, to thrust through the bottom of a fisherman's boat. He weighs 700 pounds.

"Now, those are three wonderful creatures of the sea," said Dr. Townsend. "But the wonders to scientific men who visit our Aquarium are somewhat different. The two creatures that arouse their greatest curiosity are the horseshoe crab, or *Limulus*, and the mudfish or bowfin,

and flourish. If scientists try to bring them up, they die before they even reach light and air, so that what we have to prove they exist are alcoholic specimens in museums, models, paintings and photographs.

"There is the 'Blind Ipnops', for instance. It has no eyes, but carries a searchlight on top of its head. Now, what does a blind fish want with a searchlight? Nobody knows, but perhaps the light attracts smaller fish when the Ipnops is hungry. It is brown in color, and of rather small size.

"Some night someone who has been indulging in post-Volstead is going to dream about a *Stylophthalmus*, and then swear off. The *Stylophthalmus* is a silver colored, wriggly, eel-like fish with two long stalks sticking out from his head, and eyes at the ends of the stalks. Also, he has a string of lights along either side that makes him look like a subway train.

**I**F YOU go swimming and get in to too deep water, the *Gastrosomus* will get you if you don't watch out. His mouth is bigger than his body and in fact, mouth, stomach and intestines seem to be all one. He may not see you, though, for his eyes are no bigger than pinheads and are located on the tip of his upper jaw."

Many deep-sea fish are luminescent—"lit up" in one way or another, to illuminate the surrounding gloom. There is the lantern fish, about the size of a minnow, two inches long, iridescent copper above and silvery white below, yet with nearly a hundred lights. These are made by small, round luminous organs divided in some species into three general sets, thirty-two on each side of the body, twelve arranged irregularly along head and body, and from four to

eight above or below the base of the tail. The lantern fish can turn them on or off as he wishes. They lure small fishes, and help him escape his enemy, the *Astrophotes* "eater of stars," whose favorite meal is a well lighted lantern fish.

**T**HE Beebe expedition on the *Arcturion* got from the depths some new varieties of lantern-bearing Sea Devils, hideous-looking black fishes with lights at the end of stalks or tentacles growing from their heads. These creatures are little more than eating machines, with enormous teeth outlined with luminescence. In some species, the mouth is four fifths of the body. Female deep-sea fishes have been found with tiny adult male fishes growing from the side or head or behind the gills. These parasitic males get all their nourish-

(Continued on page 151)



A Curious Parasite

How a "shark sucker" fastens itself to the under side of a shark's body by suction disks. This strange fish feeds on scraps of food from the meals of its host



An Under-Sea Toy Balloon

One of the oddest of all fishes is the puffer, which, when taken from the water, blows itself up like a balloon with air it swallows. The balloon collapses startlingly



Sea Horses That Climb Trees

The astonishing little sea horses are the only fishes that climb trees. They have grasping tails, like monkeys, with which they cling to seaweed. They are shaped like question marks, with horselike heads

known as *Amia*. The Aquarium donates many of these to European scientists. The horseshoe crab, which looks like a flattened beehive with a rat tail, is the only living animal related to the extinct trilobite, whose fossils are so well known. The mudfish, which looks like many other fishes to laymen except for a thickening of the tail, is a descendant of one of the early forms of fish life. It belongs to a line long extinct, dating back unknown thousands of years. So you see the crab and the mudfish are, like some people, interesting chiefly because of their ancestry.

"If you want to get a real thrill, go down deep into 'the waters under the earth' and see the strange creatures there. In that eternal darkness, miles down, under terrific pressure and intense cold, nature has evolved creatures that can live



# Amazing Ways We Use WASTE

*New Discoveries Feed Us, Clothe, House  
and Transport Us with Materials  
Once Considered Junk*

By LEE CARTER

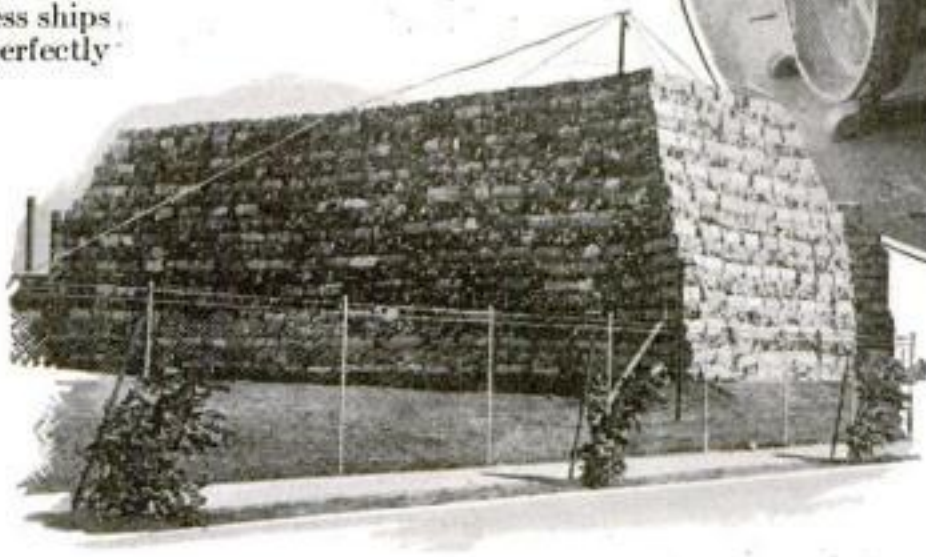
**W**HEN Henry Ford purchased 199 steel merchant ships from the United States Government he wasn't actuated by altruistic motives. It was merely a question of money value. Each one of these apparently useless ships represented just so many tons of perfectly good raw material that could be used in the manufacture of cars.

Thirty-five of these ships already have been torn down and made over into automobiles, tractors, machines and implements. The steel and metals went into auto engines and chassis; the lumber in booms and spars was turned into wheels and auto bodies; scrap wood and cork were ground for packing purposes; searchlights were sent to light Ford aviation fields; deck lumber was made into crates and boxes; even nails were melted down and the metal used again. Every scrap of the vessels torn down so far has found some use in the Ford organization.

**A**ND Henry Ford's salvaging of the material in these otherwise useless ships is but one phase of the enormous effort that is now being made in every line of industry to eke out our rapidly dwindling supply of virgin materials.

The World War, of necessity, did much to bring this new science of salvaging waste into practice. Since then there have come, one after another, remarkable discoveries of new ways to feed us, clothe us, house us, transport us and keep us comfortable with materials that once were considered junk. Weeds, cornstalks, old shoes, rags, the scraps from our tables, rusted and broken-down machines, the garbage and sewage of cities, broken boxes and barrels—these and many other

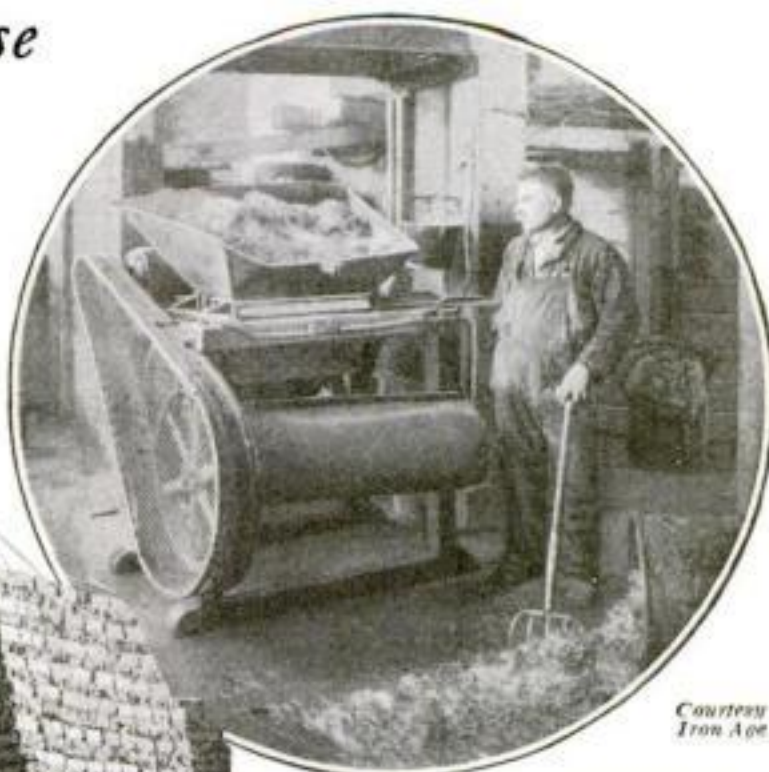
Below, piles of discarded magazines which will be converted into new paper and eventually become new magazines again, at a large plant situated near Antioch, California



items of "trash," science has found, can be salvaged, saving millions of dollars a year.

Yet even with this new knowledge the amount of waste in the modern world is appalling. An outstanding example is in fuel, particularly automobile fuel. Twenty-odd million cars in America are burning up fuel with profligate disregard of the future.

Nor is that all. In burning this fuel, even in the most efficient motor cars, there is a tremendous waste of energy. At least one third of the theoretical power of the fuel is wasted in the exhaust; another third in the radiator; still more in friction; so that in the end only a small fraction is put to work in propelling the car. Engineers are seeking to develop machinery that will salvage this energy. Meanwhile, by improved processes of petroleum refining, they are extracting useful by-products ordinarily wasted in gasoline combustion. For example, a cer-



Courtesy  
Iron Age

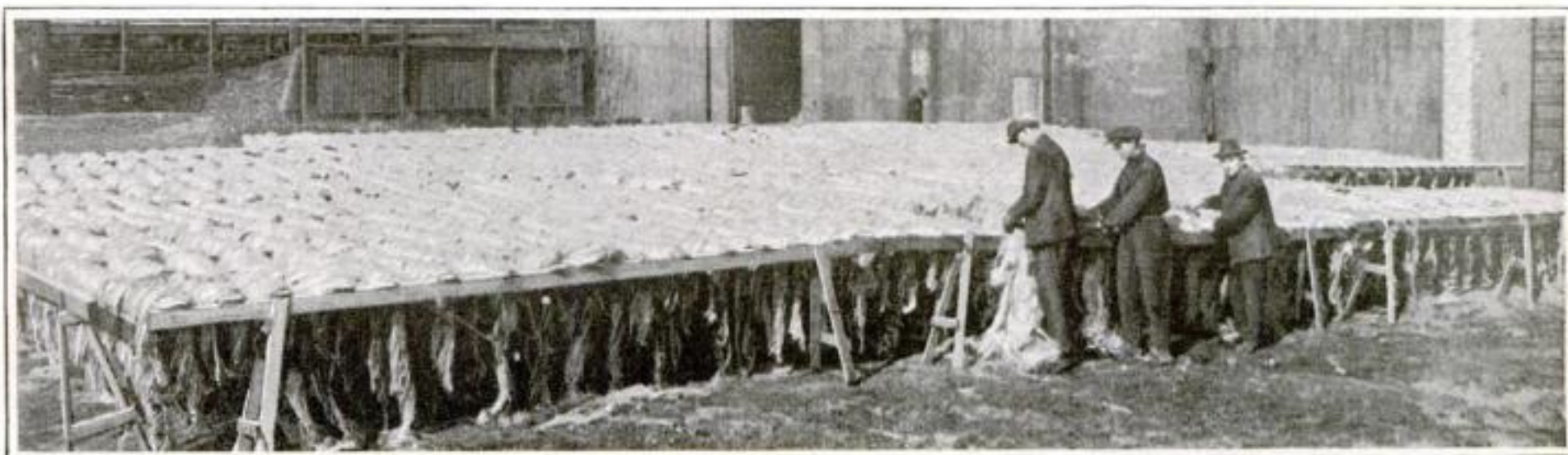
(Above) A new magnetic machine for separating high-value metal turnings from the lower-value turnings of iron and steel at the General Electric Company. The process saves \$20,000 annually in scrap

tain gummy residue which clogs gasoline motors can be recovered and used for making artificial rubber. The possibilities for such salvage work have barely been touched.

In coal consumption the waste has been equally extravagant. Of every ton of coal you burn in your furnace, at least three fourths is lost up the chimney. But here the work of salvage has progressed farther.

**G**ASES given off by burning coal are being used to increase the growth of plants. From coal tar hundreds of valuable products are being produced, while the waste products of coke ovens are responsible for the prosperous American dye industry. And only the other day chemists announced the success of a new fuel from coal which will be smokeless and almost without waste. It is called "semi-coke." Besides being smokeless, it is said to burn as easily as coal and much more easily than coke. In its production by a low-temperature process, gases, oils and ammonia ordinarily lost when coal

(Continued on page 153)



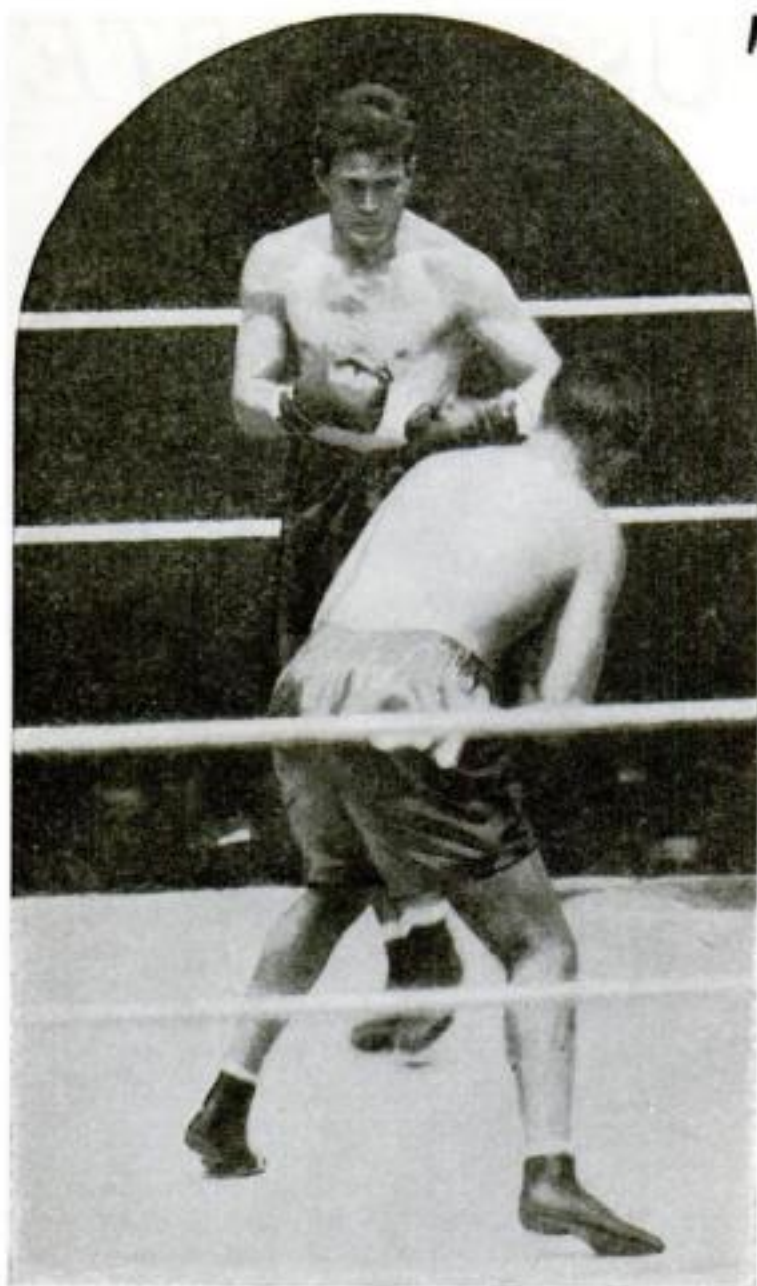
Reconditioning old ropes at a plant on Staten Island, N. Y. The material will then be shipped abroad to be made into cheap carpets,

twine, and similar products. This is one phase of the effort being made in industry to save waste in our dwindling supply of raw materials



# Tunney Tells How

*"I Practiced One Punch for More Than a Year," Says New Heavyweight Champion—Why He Knew He Could Not Fail*



**The Battle for the Championship**

Dempsey, in the foreground, is weaving in with his characteristic crouch, while Tunney waits his opportunity. Note the look of determination on Tunney's face

**W**HEN Jack Dempsey, black-browed, scowling, aflame with his innate delight in battle, leaped from his corner in the Sesqui-centennial stadium on that memorable evening last fall, it was with the confident belief that he was about to begin another of those short, vicious slaughters that had marked his seven-year reign as world's heavyweight champion.

A few seconds later, Dempsey, the "killer," the "unbeatable," had lost his championship. True, it required ten rounds of fighting—a half hour—before the title officially changed hands. But actually the championship had passed within a half minute after the fight began. It passed with the delivery of the most amazing blow ever known in the prize ring by the most remarkable young man who ever stepped into the "squared circle."

The blow was a straight right-hand punch that was aimed at Dempsey's jaw, but which actually landed high on his left cheek. I call it the most amazing blow for several reasons. First, it won the heavyweight championship for a man to whom not one person in a hundred conceded a chance. Then, it won the title without a knockout. But the most astonishing thing about it was this: Although its actual delivery required only an infinitesimal part of a second, it really started for the rugged and desperate face of Jack Dempsey about fourteen months before.

For that I have the word of the man

who conceived and executed the punch—Gene Tunney, the new heavyweight champion.

Tunney told me the amazing story of that blow on our way from New York to Philadelphia a week or so after the fight. I had informed him that the editor of POPULAR SCIENCE MONTHLY had asked me to obtain from him his own version of the battle with Dempsey.

**O**F COURSE; gladly," smiled Tunney. "I've had a warm spot in my heart for POPULAR SCIENCE MONTHLY for a long time. In June, 1925, POPULAR SCIENCE printed an article I wrote. I had called it 'What I Have Learned about the Vulnerability of the Human Body,' but the editor changed the title to 'The Blows That Made Me a Champion.' I was American light

heavyweight champion at the time, you remember; but, in the light of what has happened since, changing the title of my article was almost prophetic, don't you think? And Jack Dempsey's body," he added with a sly grin, "was just as vulnerable as that of anybody who happened to read my article.

"Anyway, I can add another blow now to the list I described in that article. Let's go back to the beginning.

"For seven years, ever since the day Jack Dempsey knocked out Jess Willard at Toledo, I'd had the idea that some day I was going to be heavyweight champion of the world. Maybe the idea wasn't reasonable at first, for then I was only a light heavyweight, a 'long string bean' of a youngster, just turned twenty-one. I had won the boxing championship of the A. E. F. in France, and I knew I was bound to grow heavier, stronger and more skilful with training and practice. Still, before the Toledo fight, I couldn't quite visualize myself as an equal match for a giant like

Willard, who stood six feet, six, and weighed two hundred and fifty pounds or so.

"Then Dempsey beat Willard. Dempsey was nearer my own size. 'I would have a chance with that fellow,' I told myself. Some of my old buddies in the Marine Corps, who'd seen me fight in France, thought so too, so I started out after the championship in earnest.

"I've always liked to think things out for myself—to plan ahead. In deciding to go after the heavyweight championship, I knew that hit or miss methods wouldn't get me far. So I concentrated on the problem and tried to list all its details in order.

"I decided that my task of winning the title consisted of three things: Perfecting my physical resources for that particular job; studying the man I was to meet, to learn the vulnerable spot in his armor, and acquiring a mental mastery over myself so that I could go through with the job unexcitedly, without mistakes and false motions.

"Kind of a large order, wasn't it?" inquired Gene. "And don't think I didn't know it. To begin with, I needed about twenty more pounds of fighting weight before I would be ready for Dempsey."

**D**ID you use any special methods for building up your body?" I inquired.

"Nothing much—aside from sane outdoor exercise and plenty of sleep," replied the champion. "I had no bad habits, no leanings toward dissipation, so it was not difficult for me to live a regular, ordered life. But I cut out tea and coffee and drank milk only; also I made it a point to keep away from the city as much as possible. Although I was born and raised in the Greenwich Village section of New York City and love my old neighborhood, I am happiest and feel best when I'm off in the country, climbing the hills, chopping wood, hiking and playing golf.

"When I first fought



**A Good Citizen**

Tunney all dressed up—a good citizen as well as a good fighter. His methods teach us a lesson



# He Won the TITLE

By ED VAN EVERY

as a professional, you boxing writers thought I was pretty terrible. Probably I was, but I was keeping close tabs on myself, practicing and training ceaselessly; I learned something new each time I fought and I realized that I was going ahead—improving—all the time.

**"AND** as I improved in skill, in strength, in speed, in punching ability, in ring generalship, my confidence in myself increased apace. This confidence was founded on facts and logic. I knew what I could do, and I knew what I could not do. Three or four years ago, for example, I would not have claimed that I could beat Dempsey. I knew then that I was a hundred percent better fighter than I had been when I was boxing in Army tournaments in France, but I knew, too, that I had a long way to go before I was ready for the 'big shot.'

"I knew three years ago, however, that I was big enough for Dempsey, which, you'll recall, was one of the essential details of my plans for winning the championship. I knew, too, that in physical condition, and ability to take punishment and recuperate, I was a match for any man in the world. My fight with Harry Greb in which he administered to me my only defeat and took away the light heavyweight championship was enough to convince me of that. Greb gave me one of the worst beatings taken by a fighter in recent years. Yet he could not knock me out, or even knock me down. So badly did he punish me that I collapsed in my dressing room after I left the ring. Yet the thought in my mind when I revived, and the one bystanders tell me I voiced when I came

## The Punch That Won

This is the right-hand punch which Tunney practiced incessantly and which really decided the championship in the first round. Although its actual delivery required only an infinitesimal part of a second, it really started for the rugged face of Jack Dempsey fourteen months before the actual combat

to was. 'He couldn't knock me out! I can lick him!'

"Having the size, then, and the stamina, my next steps were the study of my opponent's weaknesses and the acquisition of a knockout punch. Somehow there always seemed to be prevalent an opinion that I was not much of a puncher. Just why I never could see. I had knocked out men who had met the best of them without taking the count. There were, for example, Bartley Madden and Tom Gibbons. Even when I knocked out Gibbons, whom Dempsey himself couldn't put away, the general opinion of fight experts seemed still to be, 'Oh, yes, Gene Tunney is a clever boxer and pretty fast for a big fellow—but he can't hit!'

**"I** THOUGH, basing my opinion only on facts and logic, knew I had punch enough for Jack Dempsey, or any other man. What, though, was the weak spot in Dempsey's armor? Where was I to land my punch to be most effective if I got the chance to meet Jack for the championship?

"I had been studying Dempsey's ring methods. Invariably he rushed out and whaled away until something dropped. Against slow-moving big fellows like Willard and Firpo that system of fighting was mighty effective. Against a shifty boxer, though, who wouldn't permit the champion to reach him with his deadly punches, the system didn't work so well. The late Bill Brennan, who was no great shakes as a boxer, stood off the champion for twelve rounds before Dempsey scored a knockout. Tom

Gibbons lasted through a fifteen-round fight with him. Twenty-seven rounds of fighting and the 'deadly' punch of Jack Dempsey only landed once! Why? Because, obviously, Dempsey was not the superman that many people believed him to be. Fight him his way, and you were gone. Make him fight *your* way, though, and he was no more dangerous than the rank and file of heavyweight boxers. That was my cue—and I took it.

"I discovered, for example, that Dempsey could be turned around very easily—probably because he rushes forward on his toes. It was well known that his most dangerous punch was a left hook. When I was training for the Dempsey fight at Stroudsburg, Pa., many people remarked how often my sparring partners reached me with their blows. 'If that's the best Tunney can do against second-rate boxers,' they'd say, 'what will happen to him when Dempsey lands on him?' In fact, some of my sparring partners had the same idea. Only two men in my training camp believed I could beat Dempsey. Well, all I can say is that nobody saw any of my sparring partners reaching me *with left hooks!* That was Dempsey's blow; that was the punch I was training to avoid.

**"N**OW, I knew that Dempsey, when we met, would do his utmost to knock me out in a punch. He was immensely proud of his murderous wallop. And fourteen months ago the thought occurred to me that the best possible way of treating Jack to a surprise would be by reversing the process—by my knocking him out in a punch."

"What's that?" I exclaimed. "Do you mean to say you actually counted on winning from Dempsey with your first punch?"

"I did," said Gene positively. "Dempsey was accustomed to seeing his opponents back away as he rushed them. I figured that by meeting his rush with a rush, and putting all I had into a single punch, I could knock him out with the first blow of *(Continued on page 155)*



## Keeping Cool on the Eve of Battle

Tunney and Casey Jones, famous test pilot, landing at Philadelphia from Stroudsburg the evening of the championship fight. Over the protests of his friends, he made the trip—his first one—in a plane



# How Many Words Do YOU Know?

*Lawyers Use about 23,000, Mechanics 5,000—Here's a Test for Yourself*

YOU have, in the English language, about a million words to choose from to express any idea that may enter your head. Out of that million you must draw the words to conduct your business, pass the time of day with your neighbors, or write your love letters.

No one man knows all of the English vocabulary. The average man uses only a few thousand words. An intelligent artisan has a vocabulary of 5,000. A person of education knows from 8,000 to 10,000 words. A greater vocabulary than that is unquestionable evidence of superior education.

To test your vocabulary and find out how you rate, a way that affords a quick

check up has been devised by Frank Horace Vizetelly, managing editor of the New Standard Dictionary and dean of American lexicographers. He has prepared lists of words so selected that, for example, familiarity with all the 100 words in List A indicates a vocabulary of 6,000 words. It is not necessary to define each word exactly; a "speaking acquaintance" with it is sufficient. If, instead of 100, you know ninety-five of them, or any other number, multiplying by 60 will give your vocabulary.

Similarly, List B, with a 100 per cent score, shows that you have a vocabulary of 12,000 words; List C, a vocabulary of 25,000.



The man with the biggest vocabulary in the world—Dr. Frank H. Vizetelly, noted lexicographer and managing editor of the New Standard Dictionary, who devised this test

*List A. For each of the words below, you probably know 60 others. Therefore, if you know the entire 100, your vocabulary is about 6,000.*

abate	dale	jubilant	scathe
affirm	dearth	latter	seminal
ample	denote	ligament	shallow
appal	deter	manifold	sheer
balk	diction	marrow	shorn
bask	discrepancy	misprint	skeptic
benefaction	draper	muff	smart
bolt	engross	mussel	source
brig	evasion	nib	statuary
browbeat	facsimile	ode	stream
burnish	feign	onset	stud
caprice	filter	oversight	sublime
cherish	foreland	postpone	succumb
chock	forte	preamble	talc
clink	frail	prejudice	tenuity
coincide	gangway	preside	texture
commune	glazier	profess	tidal
composure	gram	protrude	tinct
consign	gravity	radical	topple
contention	grope	recommence	trawl
converge	gullet	refuge	unassuming
cosmos	horde	repress	undergrowth
crevasse	identical	revile	unfurl
crotch	inkling	roan	uppish
cue	inter	saber	whisk

*List B. If you know all of the 100 words below, your vocabulary is about 12,000. Multiply each one you know by 120.*

administrator	epicure	mace	scrunch
alloy	crysipelas	moiety	sever
antipathy	excommunicate	monsoon	siphon
aquiline	expatiate	neb	slabber
arraign	extenuate	ordain	slink
automaton	festoon	pagan	snigger
babble	fizz	parable	somnambulism
bedlam	fluctuate	peal	spawn
beeve	fulminate	perception	stamen
blowze	gabble	pictorial	steppe
bounden	goiter	pip	stipulate
brandish	hackney	pliant	sunder
carnivorous	handspike	postern	swain
caw	hilarious	primeval	tabernacle
cervine	huckster	quadrant	tolerable
clandestine	inadequate	quartern	transcend
colter	inflate	ramrod	trinal
congregate	invoke	rational	turquoise
covet	kink	residual	vellum
deign	languid	retaliate	volatile
dissonant	leaven	rife	waft
divulge	leonine	roseate	wary
duress	liquidate	rudiment	wilt
ebon	longevity	sanctum	yew
egress	lucid	saunter	zodiac

*List C. An exceptional vocabulary—25,000 words—is indicated by familiarity with all of the 100 rather uncommon words below. Multiply each word by 250.*

abstemious	ciliary	eloquence	incursion	millennium	plantigrade	sillabub	torose
ague	condone	emporium	induct	mote	poise	sodality	toxin
amain	cordate	farrier	insoluble	nape	polypus	spicular	tret
anneal	craniology	folderol	intestate	nomad	portend	spittle	trow
assiduous	curvilinear	frieze	kail	nostrum	pugnacious	springe	tyro
barouche	declivity	genealogical	labial	obloquy	purge	staminody	unmoor
bibulous	derogate	gibe	loam	ostracize	quintessence	storied	valetudinarian
bissextile	direful	heptagon	malapropos	palmiped	redundant	suppliant	vertex
blear	disparage	hoiden	matrix	paroxysm	remuneration	swob	vortex
bole	dory	hydrology	medallion	penance	replevin	syncopation	voracious
candid	drachma	imbroglio	meniscus	permutation	sediment	temporal	weazen
catalepsy	dross	imperturbable	metric	pestiferous	septuple	tessellate	xiphoid
chapfallen		incog		phosphor		thill	



# Is Your House Heated Properly?

## How Radiators Should Be Placed, Piping and Connections Planned, and Radiation Estimated

By JOHN R. McMAHON

"YOU'RE a fine pair," I informed Rob and Ellen, "to leave the heating question to the last moment, when you are about ready to move into your new home."

"Guess we didn't believe winter was coming," laughed Rob. "Besides we got tangled up in that three-cornered argument about steam, hot water and hot air."

"Does it really matter, the delay?" asked Ellen anxiously.

"It is not deadly serious," I assured her. "There are advantages in planning ahead for your heating system, and an early installed furnace gives the incidental benefit of drying out new plaster and paint. But you're a lucky couple. The fact is, you are going to win by this delay."

"Prices going down, eh?" quoth Rob.

"Better than that. A new scientific discovery that you can benefit by, not only saving your cash but adding to your comfort."

"Who is the scientist and what is his dope?"

"He is Dr. Charles W. Brabbee, a European expert who is now doing heating research for a leading American corporation. He has a laboratory at Yonkers, N. Y., where he tames the flighty and elusive thermal units, practically making them eat out of his hand."

"The gist of his new idea is simply this: More heat at the floor and less at the ceiling. A knee-high radiator, says he, does more useful work than its waist-high fellow of even larger size."

"I always thought that ceiling heat was not wasted; that it helps warm the next floor," said Ellen.

"MANY people think so," I replied, "and the idea may be correct. But Dr. Brabbee assures us that ceiling heat in excess is wasted. The Egyptians and the Romans had the right idea in putting heat ducts through their floors, but we moderns have gone astray, he suggests, with our high radiators. We have been wrongly estimating heat in mere terms of radiator surface, disregarding the vital factor of low placement."

"Did the doctor test high and low radiators together?" asked Rob.

"Yes, one thirty-eight inches high with another twenty inches high. The little fellow gave out eleven percent less heat on the old standard basis of calculation,

but in its heating effect at knee height—which the scientist claims to be the true test of practical efficiency—it surpassed its big competitor by all of seventeen percent. Add up and you see that low placement will save you toward one third on your heating system."

"Knee height does not sound quite scientific," murmured Ellen.

"That is true—Dr. Brabbee's discovery is not as exact as a chemical formula; yet it can be usefully applied. I would personally interpret it to have no radiator higher than twenty inches, or under-window size, except where a narrow space compelled taller installation. You want a cool head and warm feet. You get both by keeping down the source of heat."

"I guess the promoters of hot air systems will claim a boost from Brabbee's work," suggested the young man.

"No doubt, in so far as the floor register conforms with the general principle of a low source of heat. Of course the heating question involves other important factors.—distribution, uniformity of supply, ease of maintenance and longevity of the system."

"WOULD you advise hot air for our house?" asked Ellen.

"Winter will advise and compel it as a hurry-up job, if you don't look out," was my answer. "The one-pipe kind can be installed in a day compared with a week or so for a steam or hot water system."

"It is the least expensive of all outfits in first cost, say one hundred and twenty-five dollars put in. Steam is at least double, and hot water is still more ex-



Radiators wherever possible should be knee-high. Low placement will save you almost one third on your heating system

pensive. Of course prices are deceptive when we overlook size, quality and service. Hot air is fairly distributed from a central register in a square house, but not in an irregular or rectangular dwelling. An old method of spreading the heat with large pipes is unsatisfactory, since the pipes are cumbersome and perishable. Take the one-pipe kind or none."

"Is it true that the modern hot air furnace does not send smoke or gas into the house?" asked Rob.

"IT IS relatively true. The inner sections are sealed together with furnace putty, which tends to crack with excessive contraction and expansion of metal in fire contact, not water-jacketed as in steam or hot water boilers. Renewal of puttying every few seasons is necessary."

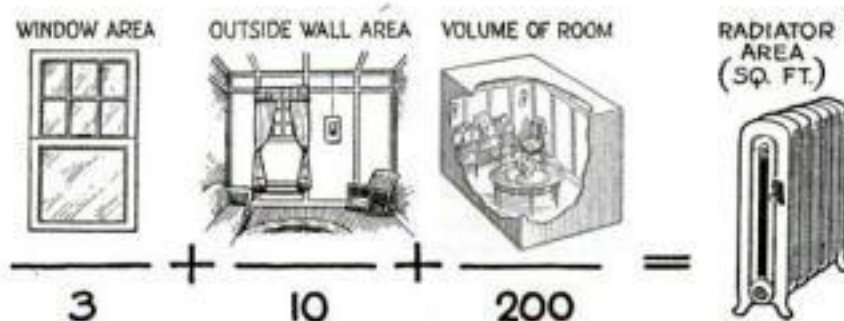
"For soft coal a solid dome of cast iron makes a tighter, more lasting job, while a steel dome serves with anthracite and, being larger, emits more heat. A firepot which has metal lugs or corrugations outside will manifestly throw out more heat than a plain surface, and it will also minimize joint-breaking movements. Don't buy a pig in a poke. Look over the furnace before it is covered with its galvanized iron jacket."

"I suppose an oil burner can be used with a hot air furnace?"

"Yes, but pick out a burner that makes little noise, because an open register or pipes convey sound easily. Any fuel from wood to oil may be used in a hot air furnace. You can also heat water with a coil inside the firepot."

"Speaking of chimney draft, what are the rules for a good one?" pursued Rob.

"For a small house an eight by eight inch flue and a chimney height of at least twenty-five feet are required. The next flue



How to figure the radiator surface area required for one room. Interpreted, this diagram means: Square feet of window area divided by 3, plus the square feet of outside wall divided by 10, plus the cubic contents of the room divided by 200, equals the total radiation which is required for heating that room comfortably



size is eight by twelve inches with a minimum chimney height of thirty-five feet. The flue should be used only for the furnace, not shared by the cook stove. Make the smoke pipe entrance air-tight with a mixture of asbestos and cement, half and half, moistened to a putty. The chimney should project at least two feet above the highest point of the roof, no flue lining exposed above brickwork and no cap or cowl placed on chimney top. Many houses show violations of these principles, and you can bet they pay the penalty in poor draft and waste of fuel."

"**H**OW can I check up on the heating contractor who says I need a certain size of steam boiler? Perhaps that boiler is too big, but how can I tell?"

"That is not a hard one for anybody who can add, subtract and multiply. You have the right notion in wanting to verify the sayso of the contractor, for your own satisfaction. There are several rules for figuring the size of a heating system, all based on seventy degrees inside the house and zero outside. They agree fairly in result. Here is a simple rule. Allow one square foot of radiation to 3 sq. ft. of glass, ditto to 10 sq. ft. exposed or outside wall, ditto to 200 cubic ft. of space.

"For example, a room 12x15x10 ft., two sides exposed, with three windows, has glass surface totaling 45 sq. ft., which divided by 3 equals 15; also 225 sq. ft. of exposed wall, which divided by 10 equals 22½ sq. ft.; also 1800 cu. ft. of space, which divided by 200 equals 9 sq. ft. Add 15, 22½, 9, and you have a total radiation required of 46½ sq. ft."

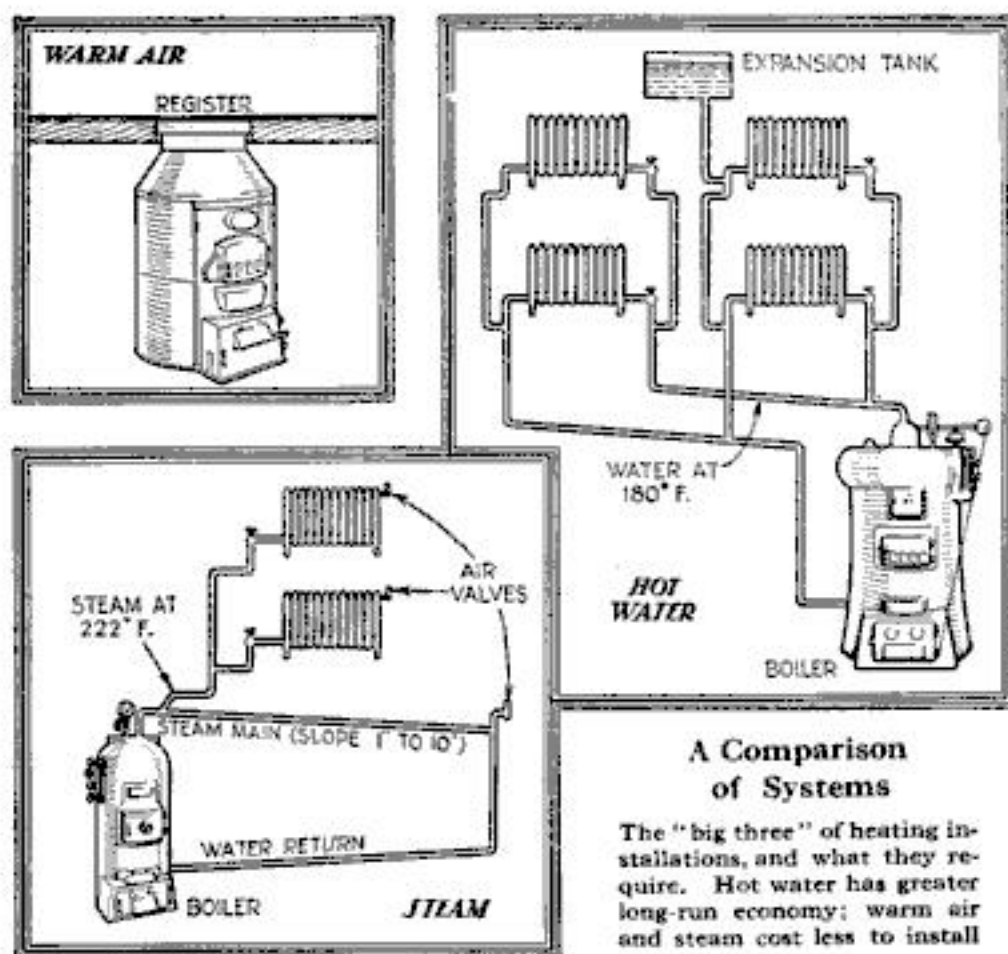
"We have to do that for each room, I suppose," said Rob.

"**E**XACTLY. And you can figure it all from your house plans instead of laboriously tape-lining each room. Then add up the total, which amounts, let us say, to 300 sq. ft. But this means only the radiator load, and we must allow for the piping by twenty-five percent, which raises the figure to 375 sq. ft.

"To this we must further add a safety margin to cover such items as extra cold weather, air leakage, poor fuel, bad firing, quick heating demands in the morning, and the fuel-saving advantage of a furnace that is not pushed to the limit. The safety margin is seventy-five percent for a well built house. We thus double the figure for room total and arrive at a grand total of 600 sq. ft., which is the indicated size of our steam boiler. A table of boiler ratings issued by the manufacturer shows that the nearest to our indicated size is 625 sq. ft. That's what we want."

"I see a chance for an argument with the contractor over that seventy-five percent margin," observed the young man thoughtfully.

"It would be better to consult a



### A Comparison of Systems

The "big three" of heating installations, and what they require. Hot water has greater long-run economy; warm air and steam cost less to install

Weather Bureau chart," was my comment. "If you have little or no weather in your locality and figure on some auxiliary heating from a kitchen range and an open fireplace, you can pare down the margin a bit. But suppose that you decide later to heat the garage from the house, or you add a room, then you may regret figuring too closely on boiler size. With a correct layout, steam pressure runs from a few ounces to a maximum of two pounds in very cold weather. A size too small means extra stoking work, more pressure, less efficiency."

"**D**OES that rule on boilers tell anything about the radiators that should go with it?" asked Ellen.

"It certainly does, about all you need to know except the new discovery of Dr. Brabbee. The radiation for each room gives the radiator size. Take the room in the example that needs 46½ sq. ft. We can look over a manufacturer's table and find what we want in almost any height, length and width. Radiators are made in sections of one coil each, so they can be as short or as long as you please. They are also made in one, two, three and four column widths. Naturally it increases capacity to multiply columns, and by the same token more width-space is required at the wall.

"If we use a two-column radiator twenty inches high—which meets Dr. Brab-

bee's knee-high preference—our cited room would need a radiator length around five feet. Of course we may divide this length into two radiators, strategically placed. A three-column radiator twenty-two inches high will do about the same work with a length of forty inches, while a four-column of similar height has to be only three feet long. We can't always exactly match our theoretical need with size and style of radiators as manufactured, but we come as close to it as possible."

"**I** WOULD like one of those low sizes under a window seat in the living room," said the young mistress of the home.

"Then you will have to add thirty percent to its capacity to allow for decreased radiation value. The same applies to any radiator

enclosed by a screen or grill instead of being placed in the open."

"What is the correct location of radiators?" asked Rob.

"Between windows, sometimes under them, along a first floor staircase—always along outside walls rather than inside walls. In a room with two exposed sides, put the radiator in the far exposed end. The north side of a house usually needs more heat than the other sides. Never tuck a radiator behind an inside door. If in time you discover that there is a mistake in radiator distribution, you can correct it by taking away a few sections here and adding a few sections there. While you can thus readjust without regard to boiler capacity, you can increase the total radiation only provided the boiler has a good sized margin of power."

"**I** HAVE heard about the vapor system," said Ellen. "What is it?"

"It is a choice variety of steam outfit. Owing to a partial vacuum in pipes and radiators, obtained by chimney draft or otherwise, the slightest amount of hot vapor in the boiler speeds through the system. Thus it heats rapidly, without pressure of more than a few ounces, and is noiseless—without any pipe thumps or valve sizzles.

"Being more elaborate, having more pipes and a radiator surface perhaps twenty percent greater, the vapor system is bound to be more expensive. Why the greater radiator surface? Because vapor or boiling-point steam has a temperature of only two hundred and twelve degrees, but its temperature rises about three degrees for each pound of pressure up to a certain point. At three pounds pressure, steam is ten degrees hotter than at the boiling point."

"Does the ordinary steam plant need more than one pipe leading to each radiator?" asked Rob.

"No. For the average home the two-pipe scheme is in the discard along with the overhead or down-feed method. There may be a

(Continued on page 157)

### Are You Planning to Build?

*MR. McMAHON'S services and those of the Popular Science Institute of Standards are available to assist our readers in solving their building problems. Letters will be answered free of charge. Write to the Home Service Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.*



# You Can Do These Tricks

*Strange Effects You Can Produce to Mystify Your Friends*

By KENNETH B. MURRAY

**M***A*GIC tricks are a never-ending source of interest and fun, though their successful performance requires skill and patient working-up. These six are unusually effective. Try them!

## The Floating Hat

**Y**OU can make an apparently quite normal straw hat cling to your hand and float through the air, then suddenly drop to the floor, to be picked up by the spectators and vainly examined for an explanation.

A flesh-colored silk thread does the trick. It is tied around the hat at the middle, allowing barely sufficient slack to place the hand under, as shown in the illustration below. To cause it to drop, break the thread by doubling up your hand. Conceal thread while hat is examined



## Water Changed to Wine

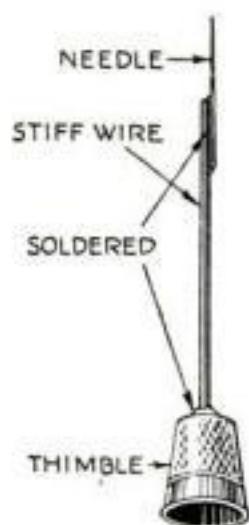
**P**OURING water out of a milk bottle into glasses, the water either changing to wine or remaining water, as you wish, is a mystifying performance easily learned.

Prepare beforehand pastes made up of aniline dyes, in the proper colors, water and a dash of liquid glue. Place specks of the paste at different positions on the mouth of the bottle, as shown above. Then, when the water is poured, you can make it carry any of the colors with it, or none at all, by holding the bottle in correct position

## Where Did It Go?

**T**HIS is a mystifying trick that can be performed at no cost and with little preparation. In view of the spectators you place a half dollar in the palm of your left hand and squeeze it with your right hand until it apparently has been squeezed into nothingness and disappears.

The secret, as revealed above, lies in a little round disk of flesh-colored cardboard attached to a piece of elastic which runs up the sleeve, where it is secured with a safety pin. The disk on one side is smeared with adhesive wax, so that the coin sticks to it and flies up your sleeve



## The Bowing Cigar

**A** CIGAR on a hat can be made to bow gracefully to the company and even do a lively dance (above). Device used is at left. Your finger is thrust in the thimble, needle point shoved through hat, and cigar held on point



## Making a Wand Rise

**T**HE drawing at the right shows how a wand can be made to rise in the hand apparently of its own volition, as above. With thread around little finger, the paper-tube wand rises as the lead weight descends



## A Mind Reader's Secret—This One Needs Practice

**A**SKING any spectator to write a question, you place the question in an envelope without looking at it (left, above), seal it, and light it with a match. Question can be seen, but not read, when match is held behind envelope while burning. Nevertheless you then announce what was

written. Here's how it is done: Cut a slit in envelope (right-hand picture), and place paper in it. Spectator's question, however, passes through slit into hand (center, above). Dummy question can be seen burning when match is held behind. Read question while spectators watch the burning



# Benjamin Franklin, *Experimenter*

BELOW, the odd sentry box on a high tower, suggested by Franklin to prove that an iron rod could avert lightning from a building. From this idea came the lightning rod now universally used



From a Thistle Print, © Detroit Publishing Co.

THIS fine painting by Charles E. Mills portrays Franklin in one of his most attractive aspects — as editor and writer. His appeal as both was universal, because he wrote as he talked, not for style but using words as a mechanic uses his tools

## *How America's First Scientific Genius Pulled Lightning from the Skies, Daring Death to Prove the Truth of His Greatest Idea*

By ARCHIBALD DOUGLAS TURNBULL

JUST as in his experiments Benjamin Franklin used tools, so in the business of life he used words. Wherever and however you take him, you will find him using language as a mason uses cement, as a bridge builder uses rivets or as a motorist uses an accelerator.

In science he could describe an experiment even better than he could make one; with the result that men "talked" back to him from every quarter of the world, often sending him valuable data for his experiments. Words were things to work with, to accomplish some definite purpose.

Think, for example, what his pen could do, after he had stood for a midnight hour beside his window, looking at a sky as rosy as if the dawn were already coming. Is it to be supposed that he could resist anything so fascinating as the Aurora Borealis or, as they call it in the southern hemisphere, Aurora Australis?

The scientific study he gave to this phenomenon absorbed him. He watched the arch, or corona, appear in the northern sky, with its highest point just about over the earth's north magnetic pole. Then he watched that corona rise higher and higher in the heavens, with streams of varicolored light—white, red, purple, and, on rare occasions, even yellow and green—flashing up through the arch to form what the Shetland Islanders call the "Merry Dancers." Sometimes he saw a single streamer, growing brighter and brighter, move swiftly across the sky and fade away. Of course, he had to sit down and write about it.

Friends in all parts of the world began

to reply to his questions as to when and how this strange and beautiful light could be seen. Sea captains, back from long cruises, told him that it was unknown in the equatorial region and very rarely noticed in any north latitude less than forty degrees. From Europe, his correspondents supplied him with results of observations from the northern countries, where the Aurora sometimes appears in long parallel rays, or curtains, billowing like a great flag tossed by the wind. Again, from others, he heard of the disturbances in the atmosphere, the terrific, unexplainable storms that sometimes accompanied these heavenly fireworks.

LIVING a hundred years too soon, he could not, of course, hear of the great storm of 1882 which paralyzed American telegraph and cable wires; burned up switchboards in Albany and Chicago; sent out currents in Bangor, Maine, strong enough to carry a message 700 miles over wire; and finally went off in a blazing Aurora over half the United States, all the Atlantic Ocean, and most of western Europe. Had he come down to our own day, his study of all these phenomena would have made it easy for him to understand that byword among radio enthusiasts—"static."

From the scientific standpoint, Franklin was not long in advancing his theory to account for the Aurora. In the first place, he held that clouds carried electricity and

that this, under proper conditions, was "condensed" out of them, much as raindrops are. Up in the Arctic regions were heavy ice fields which, Franklin decided, must block off the electrical discharge and prevent its entering the earth. "But," he said, "the electrical fire can never be destroyed, from which it follows that this must accumulate in great quantity over the ice; as more and more is condensed, this accumulation must gradually fill the whole atmosphere of this Arctic region."

Now, under the heavy pressure conditions understood to exist in these same regions, the layer or stratum of atmosphere, according to Franklin, would be very thin or narrow. Above it, the vacuum belt must therefore "hang low." And vacuum, as had already been shown by experiments of scientists, was a good conductor of electricity. Suppose that the electrical content of the atmosphere became so great that the narrow stratum could no longer hold it; then it must break through. "Running along the vacuum," cried Franklin, "it will spread in every direction in great rays, diverging as they approach the equator—until the electrical fire finds a more temperate climate and an atmosphere through which it can penetrate, to enter the earth."

THAT was Franklin's explanation, a most ingenious one for his age and day. Modern scientists have their tabulations of Aurora observations in various



latitudes, their charts of "Auroral frequency," and their estimates of its height above the earth's general level at anything from eighty to 240 miles. To read them is simply to be convinced that, fundamentally, Franklin was perfectly right. And none of them could beat him at a description.

**T**HE idea that clouds carry electricity led Franklin still farther afield in his investigations. We can get one picture of him, sitting at his library desk, making little paste-board cloud models. Suspending these from his ceiling, he hung down from them dozens of little silk threads, to which he attached his faithful friends, the bits of cork or wood which had already helped him so many times.

Generating electricity with his primitive machine, he discovered that the hanging "particles," when charged, repelled one another. If he soaked them with water, they shook off drops as they flew apart—"exactly," said Franklin, "in the manner of raindrops shaken from the clouds immediately after a lightning flash in a thunder gust."

**F**ROM this he deduced the thrilling theory that two charged clouds "opposite in fire," create, when they meet in the sky, the thunder and lightning, and that the large raindrops so often seen were thrown down by the concussion or shock.

Of course, we now know that the big raindrops are not due to the thunder, but to the lightning itself. Franklin was wrong, there, as can be proved by a simple experiment. For instance, if steam is condensed in a large jar, it forms minute water particles on the sides. If an electrical discharge is sent into the jar (a brush discharge, for example) the little particles immediately rush together, to form big drops which fall, of their own weight, to the bottom of the jar. The same effect results from such a discharge among dust particles. This fact—that electric discharge makes finely divided matter coalesce or cohere—has been made

### A True Romance

**N**EW and interesting light is thrown in this, the concluding article of Mr. Turnbull's series, on the famous kite experiment by which Franklin first drew lightning from the thunderclouds. Epoch-making as this achievement was, how many of us actually could tell any details of it? It makes as fascinating a tale as ever came from fiction writer's pen.

great use of in the development of radio telegraphy.

To go back to Franklin's day, and beyond, to the elder Pliny—Pliny, in his *Natural History*, about the year 50 A.D., spoke of the "flames of light" playing around the masts and spars of the ancient Roman ships. These lights were popularly supposed to be sent by Castor and Pollux, the twin gods who watched over navigators. A pair of such lights was taken to be a sign of fair weather and a good voyage. One light always meant "Look out for storms and danger."

**A**gain, there were the Spaniards, steeped, as all good sailors are, in superstition. When they saw these lights from heaven, they decided them to be emanations from the body of the holy Saint Elmo. "Corposants," the Spaniards called the lights, but they are much better known as "Saint Elmo's Fire," the common name even today.

In those early days, it was natural enough that these phenomena should have a religious or miraculous interpretation. But they depended, of course, upon one very important thing—points. Mastheads, yardarms, church spires, and so on—all these are pointed. And it is easy to see how their shape supports Franklin's

earlier experiments with sharp bodkins or needles for "drawing off electrical fire." He began to speculate upon what might be done, in this connection, with the charges which he believed to be contained in the clouds.

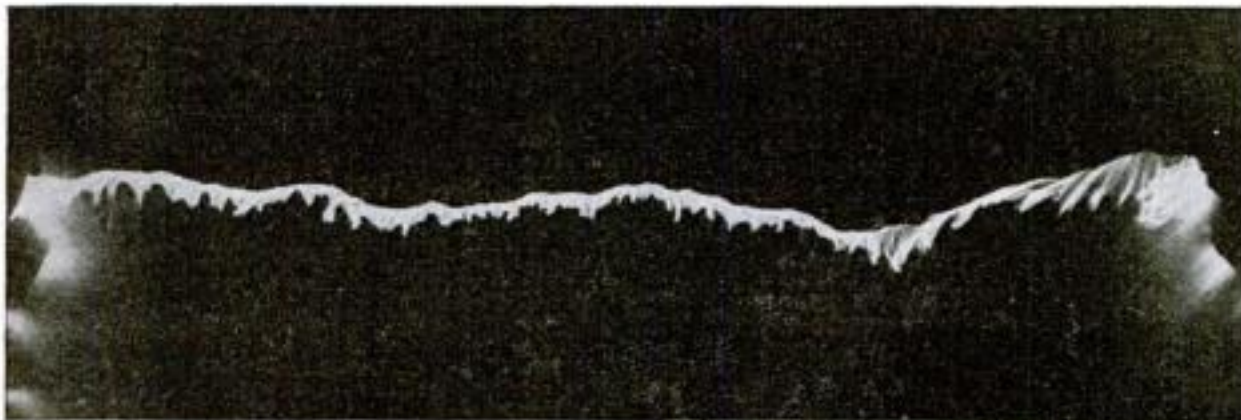
**T**O SEE a vivid, zigzag flash across the sky, and hear the distant muttering or the near-by crash that went with it, was enough to keep his curiosity on its toes. Points—always points; that was what impressed him. He wrote to his friend Collinson, the English botanist: "May not the knowledge of this power of points be of use in preserving houses, churches and ships from the stroke of lightning, by directing us to fix, on the highest parts, upright rods of iron, connected by wire into the ground or, on a ship, into the water? Would not these draw the electrical fire silently from the clouds and secure us from that most sudden and terrible mischief?"

The lightning rod, of course—conceived even before Franklin was sure of the nature of lightning. These suggestions appeared in full in his letters which Collinson made into the pamphlet, "Observations for Explaining the Several Phenomena of Thunder Gusts." But one small paragraph of Franklin's own notes will serve to show how he was reasoning.

**N**OV. 7, 1749. Electrical fluid agrees with lightning in these particulars: 1. Giving light. 2. Color of the light. 3. Crooked direction. 4. Swift motion. 5. Being conducted by metals. 6. Crack or noise in exploding. 7. Subsisting in water or in ice. 8. Rending bodies it passes through. 9. Destroying animals. 10. Melting metals. 11. Firing inflammable substances. 12. Sulphureous smell."

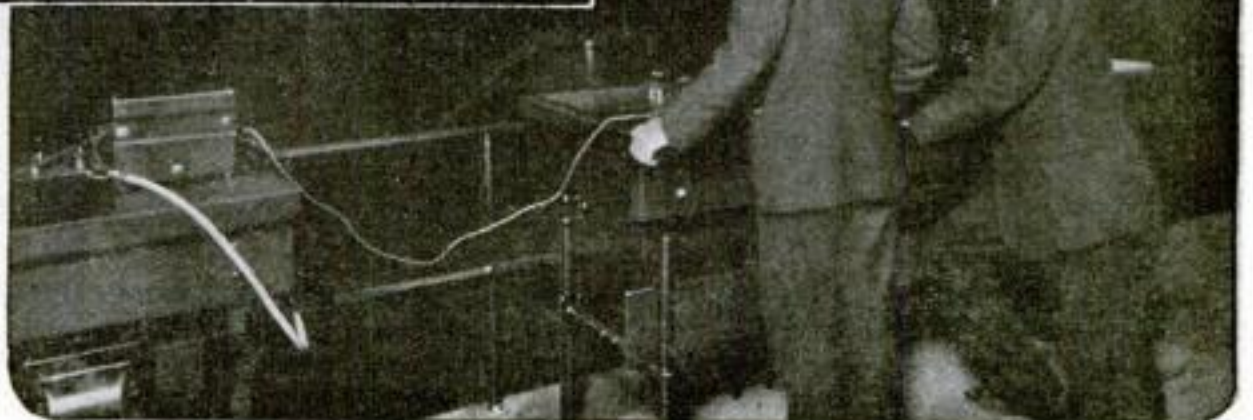
From that paragraph of a dozen steps, it is easy to see how he was building his theory and how, as always, he refused to jump to a conclusion. Some of what he said was accepted at once. For instance, Collinson, hearing that Franklin had killed a hen by electricity, tried the same thing on a turkey and reported that "it did eat uncommon tender."

Then Franklin went a little farther. "The electric fluid is carried by points,"



### Man's Nearest Approach to Lightning

**F**RANKLIN, flying a kite into the thunderclouds, proved that lightning and electricity were the same. What would he say today of that other experiment, a few weeks ago, when Harris J. Ryan of Leland Stanford University caused 2,100,000 volts to leap a gap of twenty feet in a brilliant ribbon of jagged flame! The picture above shows the bolt—the largest ever produced by man. At right, Prof. Ryan (left) at the control panel, with Allan B. Hendricks, designer of the huge transformers that were used in the experiment





he declared. "We do not know whether the same property is in lightning. But, since they agree in all the particulars wherein we can already compare them, is it not probable they agree likewise in this?" And there is a hint of Jove himself, all powerful Father of Thunderbolts, in the way in which Franklin, at the end of his notes, gives an order: "Let the experiment be made!"

Immediately he proposed one method of making the test. "On the top of some high tower or steeple," he wrote, "place a kind of sentry box, big enough to contain a man and a stand. From the middle of the stand let an iron rod rise and pass, bending out of the door, and then upright twenty or thirty feet, pointed very sharp at the end. If the electrical stand be kept very clean and dry, a man standing on it when clouds are passing low might be electrified and afford sparks, the rod drawing fire to him from the cloud."

**T**HERE is nothing in history to show that Franklin was immediately overwhelmed by a rush of volunteers who wanted the first chance at this type of lofty sentry duty, which perhaps accounts for Franklin's going on to say:

"If any danger to the man be apprehended (though I think there would be none) let him stand on the floor of his box and now and then bring near to the rod the loop of a wire which has one end fastened to the leads, he holding it by a wax handle, so the sparks, if the wire is electrified, will strike from the rod to the wire and not affect him."

This, with its provision for at least some insulation, was rather better. But unfortunately there were no proper towers or steeples in Philadelphia where the idea could be tried. On the other hand, Franklin's usual free and easy way of telling everything broadcast—through Collinson—resulted in inspiring two

Frenchmen, who took him more seriously than the English Royal Society seemed willing to do at this time.

D'Alibard and De Lor, in a pleasant little Parisian garden, set up an iron rod, about an inch in diameter and more than fifty feet high. For days they watched it, while not a thundercloud passed over their heads. Growing tired, they stationed a guard, armed with a length of brass wire and under orders to call them if a storm arose. The storm did come and the guard, without waiting for anyone, touched the wire to the rod.

Instantly there was a crash! Sparks flew in every direction. The guard, thinking his time had come, fell to the ground. His friends rushed for a priest to administer the last rites, but when they returned with him the guard was not dead. Upon that, the priest took up the wire and made several experiments himself, after which he wrote a report to the two scientists, who seem to have missed the show after all. D'Alibard then declared "Franklin's idea is no longer a conjecture but a reality."

**E**UROPE, including the Royal Society, was almost instantly convinced that lightning and electricity must be identical. Other scientists began to follow D'Alibard's example in making experiments, not always with happy results. Thus, Professor Richman, of St. Petersburg, erected an insulated vertical iron rod above his laboratory. By a metallic chain, also insulated, this rod communicated with another in the ceiling. This latter rod projected downward and ended in a ball. The Professor had added an electrometer of his own, consisting of a thread hanging beside the uncharged ball and instantly repelled by a charge.

During a thunderstorm Richman bent over to study his electrometer closely. At a heavy clap of thunder, a globe of

blue fire, large as a man's fist, leaped from the ball to Richman's head, a foot away, and killed him instantly. The other man in the laboratory at the time was so stunned that he could hardly say, afterward, just how the shock had affected him.

With such convincing demonstrations taking place in Europe, it is an odd fact that the only strong skeptic was—Franklin himself. It is not fair to say that he was merely chagrined because he had not been the first to try his own experiment; he actually was unconvinced by what had been accomplished. This was not uncharacteristic of the man, because his carefully maintained doctrine of never being too positive about anything often resulted in his having "second thoughts" which appeared to him very much "best."

**T**O HIM, the fact that a rod had been raised fifty or a hundred feet into the air and subsequently electrified did not prove, necessarily, that storm clouds themselves carried this electricity. He held that such a rod could not really reach even a low thundercloud, which was sure to be more than a hundred feet in the air. There could be but one way, he insisted, in which indisputable proof—the only kind of proof that ever fully satisfied Franklin—could be had. That was to send something actually up into the clouds, to see if it would "extract the electrical fire." Looking at Franklin, as we are, from the standpoint of his contributions to science, this brings us to him at his best and most famous.

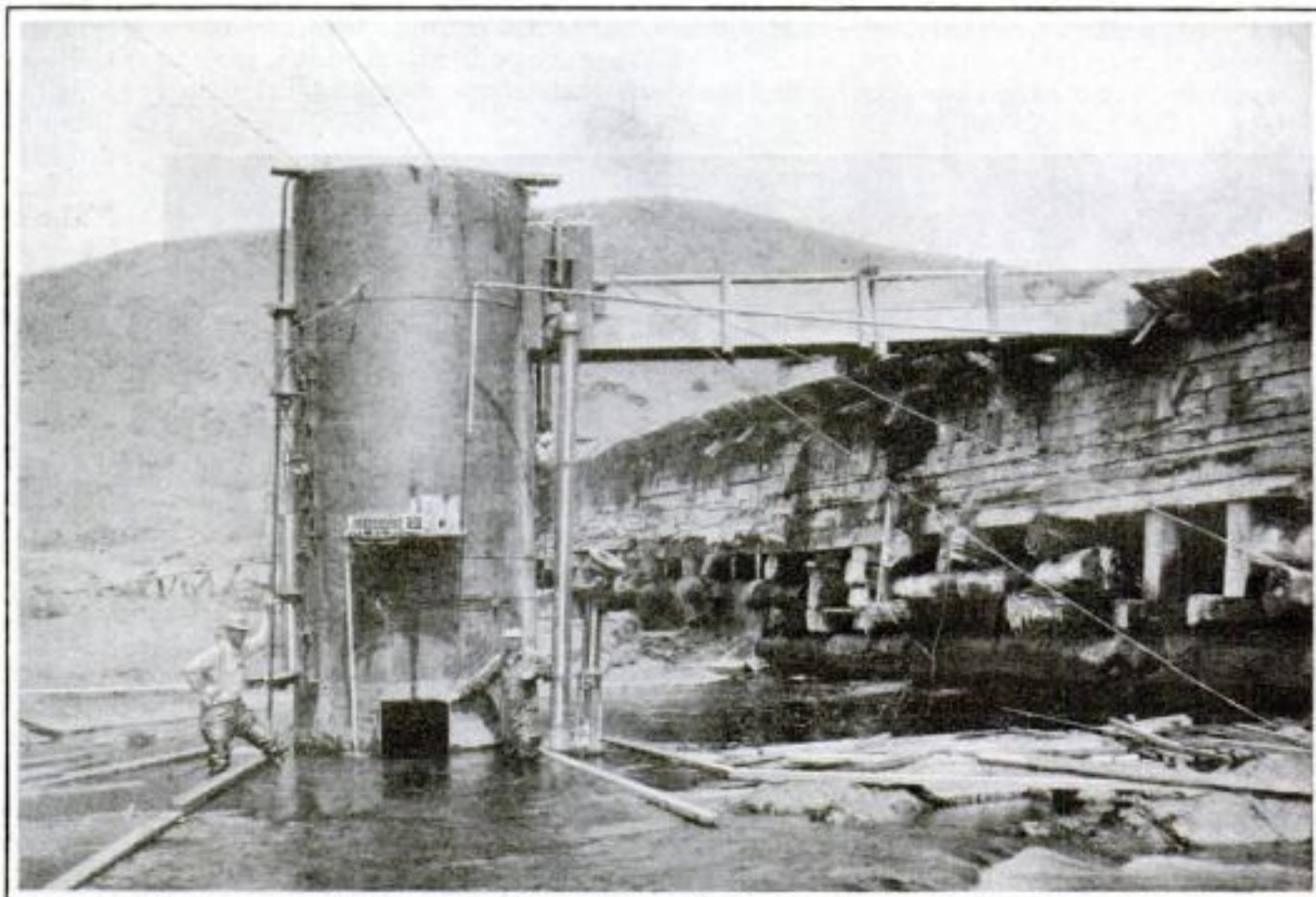
He had already erected a lightning rod, connecting it to bells that would give signals. When Mrs. Franklin became alarmed by the bells, he begged her to let them alone nevertheless; but he did show her how they could be cross-connected with wire, so they would "ring silently." In his writings, *(Continued on page 158)*

## Pampered Salmon Get Elevator Service to Ascend Streams

**E**LEVATOR service for fish is the newest thing in the famous salmon river regions of Oregon. The strange-looking structure in the illustration is a type of the new "fish lift" which probably soon will be a common sight on these rivers.

Instinct tells salmon, when ready to spawn, that they must ascend the stream to the farthest possible point to deposit their eggs. And salmon, when ready to spawn, always return to the stream in which they, themselves, were spawned. But the development of power projects for some years past has been threatening to make it impossible for the fish to ascend streams. The new fish elevators invented by J. R. Wheeler, of Reedsport, Ore., offer the solution.

Operated by hydraulic pressure, the elevator lifts the salmon (and trout too) automatically to the stream above a dam. About four lifts are made an hour, and judging by the crowded elevators, the fish appreciate the service!



Fish elevator at Winchester, Ore. Shaped like a cylinder, it is eight feet in diameter and twenty feet high. The salmon enter through the lower gate, are lifted, and exit through an upper gate



# Eight *New* Tests—Try Them!

*They'll Give You an X-Ray of Your Mental Machinery*

**Y**OU don't need to go to an intelligence expert to get a line on yourself. Puzzles can give you quite as accurate an idea as anything else of what your forte is. Especially worked out for this very purpose are these Sam Loyd puzzles, offered from month to month to the readers of POPULAR SCIENCE MONTHLY by the greatest puzzle authority in the world. You have the fun of solving the puzzle. And then you have the additional satisfaction of checking up on the time it took you to find the solution, and so arriving at a remarkably accurate rating of your ability at whatever the puzzle was designed to test—whether it was your mental agility, imaginative power, or analytical ability.

Here are eight new ones. Try them!

## Solutions of Puzzles

**T**HE correct solutions for the eight puzzles on this page will be mailed on request, at once, to any reader. Address: Puzzle Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.



## Counting the Years

**"H**OW long have we been married?" inquired McCarthy. His wife gave answer: "I've been married to you two thirds of my life, but as you are a dozen years older than I, you have been my husband six elevenths of your time on earth." To make this a test of your aptitude in mental arithmetic, note the time it takes you to give McCarthy his answer in plain figures. Ten minutes gives a good rating.

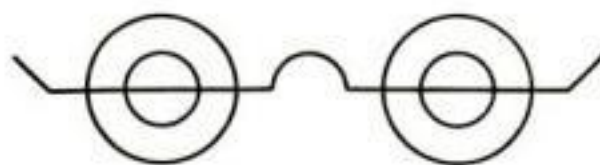
## Do You Grasp Facts Quickly?

**I**N ONE election district 7200 votes were cast for three candidates. The victor received 100 votes to every 80 cast for his nearest rival, and the second candidate scored 100 for every 75 cast for the third man. How many votes were cast for the winner?

You have exceptional ability at grouping separate sets of facts in their logical relationship, if you solve this little poser within four minutes.

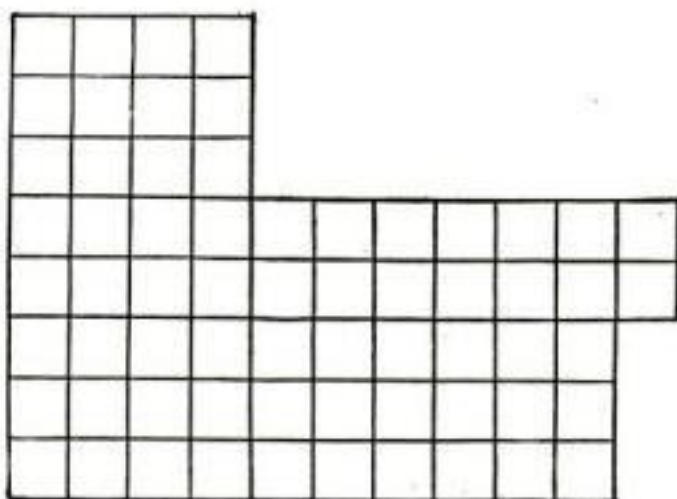
## A Test of Foresight

**A** DETECTIVE, or one skilled at picking his way among devious by-paths, will shine at the test below. This pair of old-style spectacles can be drawn just as shown, by a continuous line which does not cross at any point. Copy the figure without taking pencil from paper and never crossing a line. Twelve minutes should give you a high rating.



## Mental Carpentry

**A**N 8-by-8 square was cut into two pieces, and these two pieces were set together to form the design at the right. You are to reverse the process—reconstruct the original square by fitting together the two parts. You have good sense of form and analytical ability if you can do this in five minutes.



$$2 + 2 = 4$$

$$2 \times 2 = 4$$

$$3 + B = C$$

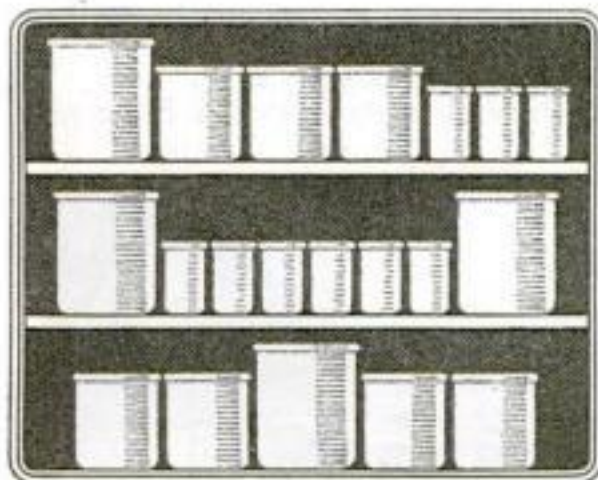
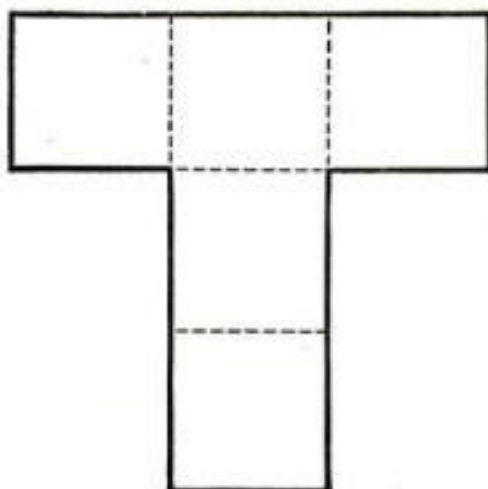
$$3 \times B = C$$

## A Simple Trick in Arithmetic

**T**HE two upper lines at the left show the only integers that, added together or multiplied together, produce a like result. Now, apply the same principle to the lower lines and find the values of B and C. The mathematically inclined mind should find the solution within eight minutes.

## One for Your Mind's Eye

**I**F YOU were a realtor and wished to divide the T-shaped piece of land below into four similarly shaped plots, rather than five, how would you rearrange the fencing, represented by dotted lines? Of course you can do it, but how quickly? Eight minutes indicates keen sense of form and balance.



## Jars for "Math" Stars

**U**PON the three shelves illustrated above are twenty jars of three different sizes. They are so grouped as to have the same jar capacity upon each shelf. If the smallest jar holds three pints, how many quarts do all twenty of the jars contain? Time yourself! Seven minutes to solve this test rates you high in mental agility.



## Building Up Words

**I**N THE test above, you are to exchange one letter at a time from the second row to the first, each exchange producing a different three-letter word which eventually will evolve APE into MAN. The test is to work out the evolution by using the fewest possible words. ARE is the first step, what are the others?



# Our Haphazard Roadside Signs



## Motorists Doubly Protected

The mechanical flagman above warns of approaching trains by swinging and ringing a bell. Out-of-order, a conspicuous red blade drops into position. This idea is from California



(Left) Practically the sole protection for an Eastern grade crossing. It doesn't tell when a train is coming



Dangerous advertising signs, tending to make motorists disregard genuine warnings

**I**N THE town where I live there's a steep hill, with a railroad track at the bottom. The main highway comes to that hill, turns down, and crosses the track beside the station. When a train comes, there's a great to-do. First, far away, you hear the engine howl. Then a gateman blows a warning whistle. Then he lowers the long gates, striped black and white. Then an automatic warning bell begins to ring. Then the express roars through.

That looks pretty safe—for a railroad crossing. So it is, as far as any blind grade crossing at the foot of a steep hill on a well-traveled highway can be safe—in the daytime. But at night the gateman goes off duty. That doesn't stop the trains any, nor the autos on the highway. But from the time the gateman leaves until he goes on duty again in the morning, it's a case of catch-as-catch-can. Any morning you're likely to come down that hill and find a brand-new automobile wreck piled up beside the railroad track. Last year there were five.

The fact that the crossing is protected during the day makes it all the more dangerous at night, especially for drivers who use it often, because of the reliance you put on the gates.

Of course the train whistle and the automatic bell warning that was installed in the days of slower moving and less noisy vehicles remain. Also, right beside the track, there's a big wooden

cross arm "Stop, Look and Listen" sign to tell the coroner it was a grade-crossing accident.

Last winter one woman, driving at night in a heavy snowstorm, became confused when at the last moment she suddenly saw a train coming. She turned directly on to the tracks. By some miracle she got both the children she had with her out of the machine and jumped out herself, before the crash came. Luckily, also, the train wasn't derailed.

Many of the lesser-used crossings hereabouts are not guarded by anything at all except the old wooden cross arms, set close beside the track. On

this is used universally. Whenever a train approaches, a red disk starts swinging, a red light in the center of it is flashed on, and a warning bell rings. It provides, on the whole, a mighty effective warning. The motorists' railroad crossing sign a hundred yards or so back along the boulevard is, of course, used also.

That amazing discrepancy in warning devices between the East and the West was driven home to me when I took my family across the continent from coast to coast. It was only one of a number of almost equally startling discrepancies that we noticed, that left me wondering why warning devices and other safeguards that have been proved highly successful in some states aren't adopted in others.

**T**ODAY, for instance, after the grade crossing wigwag has been demonstrating its superiority on the Pacific coast for something like fifteen years, you will find, in the Grand Central Terminal at New York City, a flashing red light installed, as a sample of what is advocated for use at all grade crossings. Because of its similarity to other blinking signal lights, because of its lack of attention-catching motion, because it's so much less noticeable by day than at night, it is utterly inferior to the familiar warning of the West. How anybody can advocate its use instead of the wigwag is a mystery.

We left New York early in December. Eighteen days later, going by way of Texas to avoid the cold, we were in Los Angeles. Two hundred miles a day—and we learned a lot about motorists' warning signs that fail to warn and safeguards that fail to safeguard. Coming back in the spring along a more northerly route, we learned some more.

Signs and safety devices for the pro-



A "dangerous hill" sign that prevents many accidents when roads are slippery from rain



tection and convenience of motorists group themselves under four heads: warning signs and safeguards; route signs; speed laws and traffic regulations; and hand signals.

Traveling across-country as I did, I was dumfounded to find how much variation there is in all four of these classes, and how unbelievably far some states are behind others in adopting the best.

The warning signs and devices, like the grade-crossing signals described above, are the most important of all.

MARYLAND was one of the first states in the East to put white lines down the center of the boulevards at all curves. Gradually other states have followed suit until that particular safeguard is now widespread. But we found in Maryland, also, signs prohibiting parking at curves or dangerous spots where the white line in the center was considered necessary. Obviously a wise precaution—but have the other states copied Maryland in that, or in a lot of other sensible road regulations? You can answer from your own experience. Up in my neck of the woods, where the roads are crowded with week-end glory-riders from New York City, you're likely to come around a sharp corner anywhere and find half the road blocked by an admiring family watching father change a tire.

In parts of Ohio and some other mid-west states, we found a line running all the way down the center of the boulevard, instead of just at the curves. It was a decidedly good thing. Every time we passed another car we knew whether we were on our own side of the road, and whether the other fellow was on his. If you don't believe that's a help, try passing a couple of big interurban busses in Pennsylvania or New Jersey, or maybe a ten-ton truck.

Other states, apparently, had never heard of Ohio's common sense line. When we left that section of the country we left that road-center safety line behind, and we never found it again until we got back there.

ALSO, in Ohio, we found in places a white line at the edges of the road—one of the greatest safety devices for night driving you can possibly imagine. Why don't other districts try it?

When a state or county goes to an expense of twenty or thirty thousand dollars a mile—and sometimes more—for concrete boulevards, why begrudge a few hundred dollars for paint and road signs to make its expensive road safe to travel on?

Road signs! There has been a tremendous improvement recently in regard to them, it is true, and the slow states, at last, really are beginning to try to catch up. Already many states have installed curve, crossroad, and other warning signs on all main boulevards; though they're slower at taking up the safety directions for stretches of road that require unusually careful driving. Maryland—one of the leading road-posted states—has directions at the tops of all dangerous hills, giving, usually, the length of the hill, and telling you what gear to descend in. There are flashing lights and reflectors at curves and crossroads for night



(Left) Kansas takes no chances—her signs are easy to read. (Below) Dangerous curves are also marked in New York. The signs, however, are not so easily read as the Kansas type

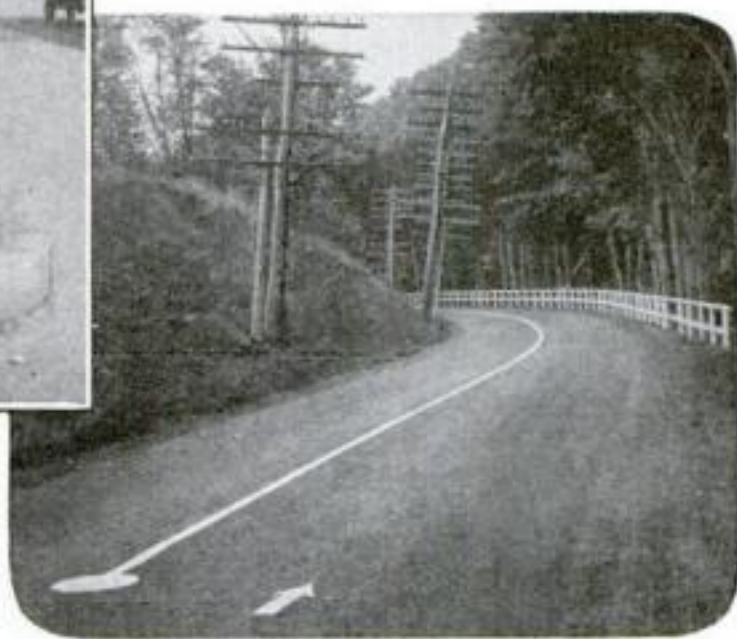
(Below) A danger sign that is coming into wide use. It has a mirror with a red glass front. At night an approaching auto headlight is reflected in it, giving the red light, a danger signal



(Below) In Texas most main route signs are clearly marked. Here even a small culvert has been put to work



(Above) Within fifty miles of New York City you still find important intersection signs like the above that you must take a day off to read



(Above) A tried safety idea—the white chalk line, keeping motorists on the right side of road

driving, and top-of-grade blinkers of a different color that supplement the daylight warnings.

But have those simple, sane precautions been taken in your vicinity? They haven't in mine—nor in hundreds of other districts we passed through. You can slide over the top of that hill I spoke of in my own town, with the bad railroad crossing at the bottom, without a word of warning. You're supposed to know about it already. Our roads were made for us to drive on, and visitors use them at their own risk—or so we tell them, in effect.

Yet in California they put up signs reading: "Caution—Hill Slippery in Wet Weather." Signs like that, obviously, are not for motorists who know the hill, but for strangers who don't know it.

Road signs, in the old days, were put up high. That was so they could easily be read from the top of a load of hay, I

suppose. Maybe horses could see them easier, too, and the drivers of hansom cabs. But autoists sit relatively near the road. A sign three or four feet above the ground is easier for them to read than one six or eight feet up. Most of the states have already discovered this. Yet an amazing number of them still put the signs clear up in the air for hay wagon drivers. California, though ranking with Maryland as one of the best posted states in the Union, is still a surprising offender in this respect.

MISLEADING advertising signs cause serious accidents and consequently have been legislated against already in many states. In others the danger still persists. Imagine coming down a boulevard to a sign that reads—as many signs do—

**STOP!**

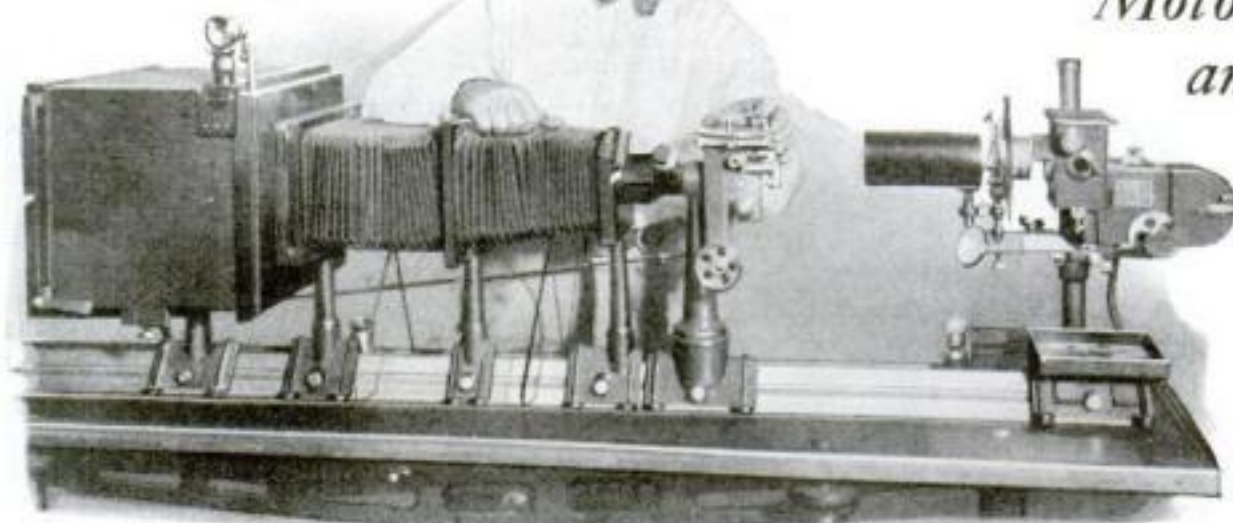
For Gas and Oil

You are rolling thirty-five, we'll say, and you pick up that STOP long before you see the little words under it. So you pull your

(Continued on page 161)



# Keeping Up with Science



## Remarkable Camera Magnifies Steel Speck 15,000 Times

A world's record in minute photography was set by Dr. R. G. Guthrie, of Chicago, when he recently magnified a particle of steel 15,500 diameters. The camera, shown above, did not vibrate by a two-thousandth of an inch during the hour-and-a-half exposure

*On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.*

## Mystery of 500,000 Years Ago in "Missing Link" Skull

**M**ATERIAL for piecing together another fascinating chapter in the story of man's origin on earth comes from Trinil, in Central Java. There Professor Heberlein of the Netherlands Government medical service has just discovered the complete skull of the strange manlike and apelike creature who lived half a million years ago, called by scientists *pithecanthropus erectus*, and popularly termed "the missing link."

The latest discovery was made near the spot where, in 1892, Prof. Eugene Dubois of Amsterdam University first found fragments—a skull cap, two teeth, and a thigh bone—of this earliest known creature resembling man. Scientists who have studied these fragments believe that *pithecanthropus erectus* was not a direct ancestor of man, but rather a cousin of the human race many degrees more human than any of the manlike apes.

A study of the complete skull, including the all-important skull base, may go far toward bridging the mysterious gulf between man and the ape. At the same time, it may serve either to substantiate or reject the astonishing theory recently advanced by the German anthropologist, Dr. Max Westenhofer, that the apes are really descendants of ancestral man.

## Would Set Snakes to Kill Rats

**I**F YOU are troubled by rats, gophers, or other harmful rodents, why not try keeping a pet snake or two about?

In experiments in the zoological laboratory of the Kansas State Agricultural College, Prof. Frederick L. Hisaw and Howard K. Gloyd have determined that the bull snake is death on rodents, and as such is a real benefactor of the farmer. After a study of forty of these snakes, kept in large sunny cages, they found the reptiles to be "gentle, easy-going creatures, quite unappreciated."

The experimenters put live rats into the cages of the "pets" and observed how the snakes captured their prey, and how much of such food each consumed.

"A bull snake weighing about three pounds eats more than three times its own weight in rodents in the course of six months," Professor Hisaw reports.

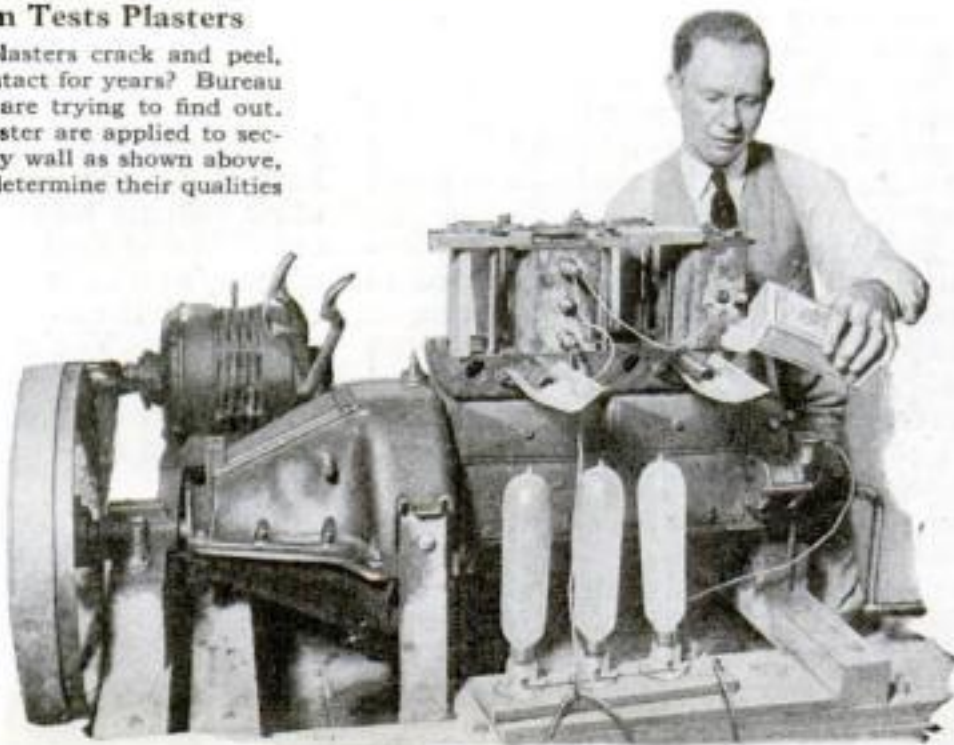


## How Uncle Sam Tests Plasters

Why do some wall plasters crack and peel, while others remain intact for years? Bureau of Standards experts are trying to find out. Different kinds of plaster are applied to sections on the laboratory wall as shown above, and tests are made to determine their qualities

## Cornstarch to Run Our Cars?

Floating dust, it has long been known, may explode with considerable violence. Now science is trying to use the same principle to find a new motor fuel. The photo shows Dr. W. A. Noel, of the Department of Agriculture, pouring cornstarch into the intake of an automobile engine specially arranged for these experiments



## Motors Run by Cornstarch and Bridges Sprayed with Metal

"This is equivalent to twelve adult pocket gophers a year. One three-pound snake should be able to clear an acre and a half of alfalfa land of rodents."

One five-foot bull snake might save a farmer \$3.75 a year, he estimated.

## Tooth Decay Prevented by Diet of Fish and Cabbage

**B**EFORE many years the dreaded visit to the dentist may be a thing of the past. In place of drillings and fillings to preserve the teeth, we may substitute an easy diet of fish and cabbage.

Such was the recent prediction made by Dr. Bernhard Gottlieb of the University of Vienna to the International Dental Congress at Philadelphia. Tooth decay may be prevented by eating certain foods, he declared, and within five years the dentists hope to have enough scientific data to present a definite tooth-preserving diet.

"We have found," he said, "that weight-giving food which builds up the body tissues does not feed the teeth, and we have been trying to isolate foods which will do so. Experiments with sea foods have encouraged us to believe we are now on the right track."

He named cabbage, brussels sprouts and spinach as other valuable tooth builders besides fish, for the reason that they contain lime salts which are the basis of tooth enamel.

## Cancer Called Nonhereditary

**O**NE by one the deadly diseases which afflict mankind fall before the advance of research workers and scientists who devote, and sometimes sacrifice, their lives to the cause of health. Now more than a hundred specialists from



eight countries have combined in unanimous agreement on fifteen important conclusions regarding one of the most dreaded diseases of all times—cancer.

These specialists, including physicians, bacteriologists, surgeons, and experts on radium and X-ray, met at Lake Mohonk, N. Y., a few weeks ago under the auspices of the American Society for the Control of Cancer. Most important of their conclusions were:

1. For all practical purposes cancer is not contagious or infectious.
2. Cancer itself is not hereditary.
3. Surgery, radium and X-rays are the only justifiable treatments for cancer.
4. Cure depends on treatment in the earliest stages.

Cancer in some parts of the body can be discovered at a very early stage, and people should be on guard to recognize the danger signals. Dentists can help by knowledge of the causes of cancer, the experts agreed, especially with relation to imperfect teeth and badly fitting dental plates. Many lives, they emphasized, could be saved which now are sacrificed to unnecessary delay.

### Man Can Be Beardless and Bald—If He Wants To

**T**HE time may come when men, if they want to, can relieve themselves of the bother of the morning shave, and when women won't need to worry about bobbed hair any more.

This promise is held out by H. C. Brooke, English naturalist, as the result of experiments in the regulation of hair growth. Hair, Brooke says, is purely a matter of heredity. In his experiments he produced a strain of mice whose heads became bald in sixteen days. A few days later they lost the fur on their backs, and a little later all their hair!

In Germany another scientist, Felix Pinkus, has been finding out just what happens in the life of a hair. For seven years he kept a record of one of his hairs. He found that it grew only 264 days in a year. In summer it grew for 140 days, while in winter it rested after 124 days. In summer, he found, hairs get a quarter of an inch longer than in winter.

### An Important New Steel

**S**TEEL that would be soft enough to shape easily, yet with a surface hard enough to withstand the wear of moving

### How Huge Cables Are Tested

Said to be the largest cable tester of its type in the world, this 1250-ton machine was built recently for English bridge builders. Right: Huge cables being fixed into the crosshead for tension tests. Dials record the breaking point. Below: Examining the ends of cables broken under terrific tension.



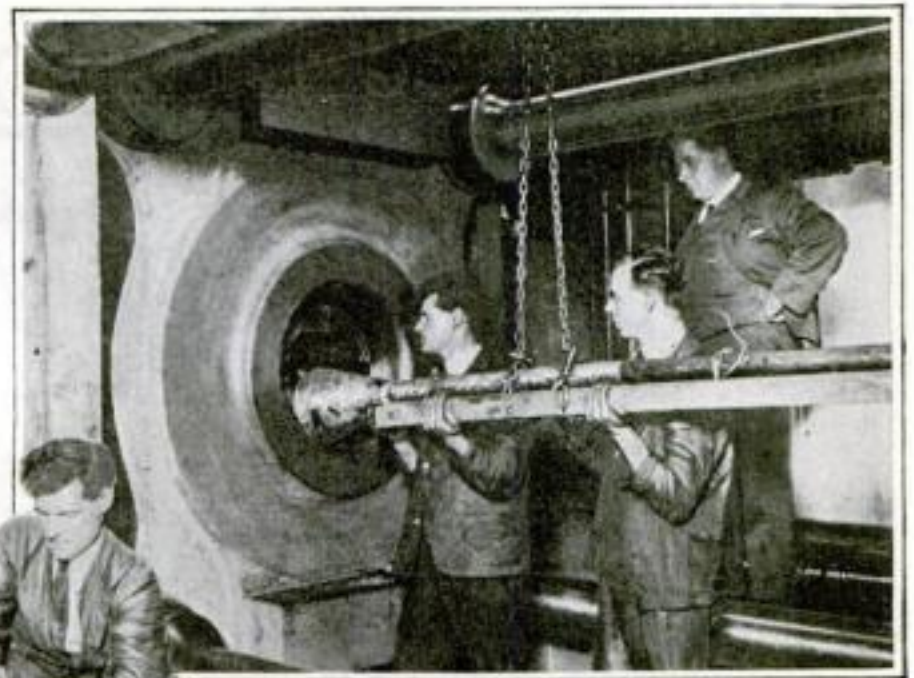
parts, long has been the dream of machine builders. Heretofore the steel used in moving parts has been hard throughout, and difficult and expensive to "work." Now a new steel has been produced at last by metallurgists of a Pittsburgh steel corporation, which has a soft core with a hard surface "skin." The discoverers predict that "jalcase," as the new steel is called, will greatly reduce production costs and speed up output of parts for automobiles, washing machines and other household appliances, typewriters, adding machines and machines used in the manufacture of clothing.

### New Rays from the Stars

**S**TRANGE rays coming from a certain group of stars, far more powerful than X-rays, have been discovered by two Swiss scientists who braved the bitter cold of a mountain peak for a month to make their remarkable discovery. On the summit of Monch Mountain, at an altitude of 13,465 feet, a small tent has served as observatory for Dr. Kolvorster and Dr. Deesalis, who despite the Arctic temperature have made unceasing astronomical observations, ending in the discovery of the

### He Sprays with Molten Metal

The photograph at the left shows a metal gas burner being coated with "metal paint" by a remarkable new spraying process recently invented in England. The "paint" is wound around a large spool in the form of wire, which is melted and sprayed on the article. Steel bridges and ships, it is predicted, will soon be painted with metal by this easy process.



new and as yet unnamed strange rays.

These untiring scientists hope to harness and use the extraordinary new rays for scientific and therapeutic purposes. The intensity of the cold finally forced the men to descend to Interlaken, where they made known their discovery.

### The Best Buys in Meat

**S**OME surprising things about the food values of things we buy and eat recently have been revealed by experts on nutrition. For instance, Dr. A. T. Edinger, of the University of Missouri Agricultural Experiment Station, who has made a special study of the American bill of fare, tells us that the cheaper, tough cuts of beef contain more value in calories than the expensive bits, and that in fact the "choice" porterhouse steak is the worst buy of the lot.

He has found that a rib roast is more economical than a loin roast, and that a clod or chuck produces the most boneless meat at lower cost than any other roasting portion. If your wife asks for a piece of beef off the "plate," he advises, she will get the best bargain of all.

In general, he adds, it is best to buy from a piece of meat that is only medium fat, for this provides the largest amount of protein or muscle-building material.

From the department of nutrition of the American Institute of Baking comes the interesting information that an ordinary ham sandwich, if topped off with a glass of milk, is "a complete food."

### In Air Mileage U. S. Leads World

**W**HILE we frequently hear it said that Europe leads the world in air transportation, in at least one point it is far behind the United States. Total air mileage in the United States over a period of a year now doubles that of France, the most active European nation in aviation.

This estimate comes from Archibald Black, consulting air transport engineer, of Garden City, N. Y., and is based on statistics compiled by the Aeronautical Chamber of Commerce. These indicate that air mail and passenger routes in this country, when a year's operation for all has elapsed, will approximate 6,000,000 miles, as compared with 3,000,000 miles covered by regular air routes in France during the same period.



# Thrills of Modern Explorers

*Sand storms and bandits make deserts still perilous—Power from ocean tides—How insects provide for their children—Reviews of some of the new books*

By THOMAS M. JOHNSON

## "On the Trail of Ancient Man"

By Roy Chapman Andrews. Published by G. P. Putnam's Sons

THE North Pole has just been flown over; Beebe has delved into the sea; the Roosevelts have climbed the roof of the world. And now comes the story of another thrilling adventure of modern explorers, the American Museum of Natural History's exploration of the Gobi desert in Mongolia.

In his book, Mr. Andrews, leader of the expedition, tells of some of its exciting experiences.

Bandits who attacked the scientists were routed by the charge of an automobile with cut-out open. Their frightened desert ponies ran away, rearing so madly the bandits could not even unsling their rifles to reply to the shots from Mr. Andrews' revolver.

Another time the expedition was nearly buried by a sand storm swooping across the desert, "an ominous tawny bank advancing at race horse speed." Trying to walk through it was like pushing into a "fantastic yellow wall, which gave and closed behind as one advanced." Most of the party "rode it out" lying on the ground in the battered tents, faces buried in wet cloths. Walter Granger, chief paleontologist, was buried to the neck in a pit. After an hour the gale dropped suddenly into flat calm.

Then, after camp had been shoveled out, the tawny cloud appeared again. This time it was a sand spout that whirled around for five minutes as if trying to suck tents and all into the vortex, then danced away across the plain. For ten days after there was never enough calm to make it worth while to clean up either camp or campers.

In late May, two adventurers fought for three days through a blizzard and its aftermath of snowdrifts to Urga, just after leaving a camp that lay drenched in heat waves.

AT ANOTHER camp, a swarm of poisonous pit vipers invaded the tents at night. The snakes coiled about all four legs of camp cots, about shoes, and gasoline boxes. A Chinese chauffeur killed one, then picked up his cap and another fell out of it. Dr. Loucks put his hand on one lying on a gun case. Luckily the cold had made them sluggish. After dark all walked about with flashlights in one hand, pickaxes in the other.

Andrews and Mrs. Andrews had a narrow escape from the shaggy black Mongolian wild dogs that feed upon dead natives and will attack the living. They

awoke one night to find a grewsome circle about their sleeping bags. The dogs attacked one member of the party and he had to kill two.

Other animals were more agreeable. Many of them were so curious they would chase an automobile to see what it was. In a short dash a gazelle could beat the

From "How Insects Live"



### Beetles Rolling Their Food

A devoted couple of sisyphus beetles engaged in the task of providing food for their family. The father, upside down, is pushing with his hind legs, while the mother clutches the ball, moving backward. Later they bury the ball

car, for it made sixty miles an hour. The wild asses made forty.

As a result of its discoveries, the expedition offers the conclusion that Asia is mother of the continents, whence reptiles and mammals spread to Europe and America. It predicts that "a relatively large-brained, erect-walking ancestral type of man" will eventually be discovered there, in proof that Asia was the chief center of human origin.

### "How Insects Live"

By Walter Housley Wellhouse. Published by the Macmillan Company

THEY live in mysterious ways and very interesting ways, according to Mr. Wellhouse. As witness, the sacred scarab beetle, valuable not only as model for the jewelry trade, but as the original pushball player, at least of the insects.

The scarab makes his own ball, of refuse, and about as big as an apple, and so bigger than himself. He pushes and pulls it—mostly pulls it—about, looking for a good place to bury it. When he does, he digs a hole, rolls the ball into it, climbs in after the ball, and plugs up the hole after him. Then he has a big feed, spending days and nights eating up the ball.

When all his buttons are strained, he comes out again, to start a new ball rolling.

The female scarab beetles hide their eggs in similar balls and then bury them.

When the young ones hatch, they eat the ball and then emerge into the upper light and air of competitive life, where they have to roll their own.

Slightly more grewsome is the trick of the digger wasp. It buries its egg with two dead caterpillars, to feed the little ones. After burying the egg, it hammers down the ground with a pebble.

The cicada lives in a hole in the ground, sucking sap from roots to get strength for a brief day on earth. Crickets, ants and katydids hear with their legs. These are only a few of the fascinating things this book tells of the intriguing ways of insects.

### "The Tide"

By H. A. Marmer. Published by D. Appleton and Co.

CAN water take the place of oil? Does the rise and fall of ocean tides generate power enough to replace that of the American gasoline supply?

Mr. Marmer thinks that tidal power may some day become of real importance in propelling a civilized and mechanized world deprived, in part or wholly, of its coal and oil. He is assistant chief of the division of tides and currents of the Coast and Geodetic Survey, but says, nevertheless, that those optimists who predict that once the tides are harnessed they will make the whole world go, are wrong.

Development of tidal power is not economically feasible where the average tide range is less than ten feet, Mr. Marmer finds; and development of large power is not feasible unless it is twenty feet. There are only fifteen such places in the world, and only one of them is in the United States, the St. Croix River, Maine. Greatest is the Bay of Fundy, the arm of the Atlantic separating the Canadian province of Nova Scotia from New Brunswick and the state of Maine. Here the tide rises forty to fifty feet in six hours, then falls again in another six.

THEORETICALLY, the maximum horsepower available where the tide rises ten feet is 7200 per square mile of tidal water; when it rises twenty feet, 28,800. So in a basin of twenty square miles and twenty-foot range, the theoretical maximum horsepower would be 576,000. Practically, only a fraction could be utilized.

The only system that holds possibilities of providing big power plants, we learn, is the basin system. It consists of one or more basins cut off from the ocean by dams. As the (Continued on page 163)



# July Picture Contest Winners

## First Prize

**T**O MAKE certain of finding all the mistakes of John and Mary and the artist in our July Picture Contest, Harold Stewart, of San Diego, Cal., built from odds and ends a model stairway and balcony like the one shown in the contest picture. "What a glorious unveiling of mistakes as the model progressed," he writes. His completed handiwork came as part of his entry, and the judges have awarded him the first prize of \$500. Mr. Stewart is an insurance salesman, and lately reached his 31st birthday



## Second Prize

"Such puzzles as these are good to keep the cobwebs off the brain," says C. R. Helper, of Sturgis, Mich., winner of the second prize of \$100. Mr. Helper is a cabinetmaker whose diversion is puzzle solving, "including with it," he writes, "the added recreation of beating carpets, washing dishes, and mowing the lawn"



## Third Prize

The \$50 prize won by Egbert C. Everest, of Plattsburgh, N. Y., goes to a worthy cause. "I shall use it toward my daughter's college course," he tells us. Mr. Everest, besides being an attorney, is quite a handy man with tools

## Others Who Share in the \$1000 Prize Awards



Mrs. John Kruger, of Toledo, O., had a valuable assistant in her husband who, she says, "delights in tinkering"



Having entered each of the previous Picture Contests, E. A. Oliver finds that "persistence wins." He resides in Los Angeles



Louis C. Flocken, M.A., is head of the department of mathematics in Wilbraham Academy, Wilbraham, Mass. Solving puzzles is his hobby. Here he is with his little son



An instructor in manual training at La Crosse, Wis., Matt J. Hefti found the Contest offered many valuable suggestions



Starting the contest "just for fun," Marguerite Goepel, Orlando, Fla., became so fascinated that she spent many hours to make her list complete



Alfred T. Renfro, Bellevue, Wash., who won the first prize in our April Contest, is back again a winner. Here he is with his daughter enjoying his vacation



"My wife shares in the honors, for we worked together," says Harry R. Samuelson, a pressman in the Government Printing Office, at Washington, D. C.



Ruth Laura Winders, Columbus, O., found a lot of mistakes by re-drawing the contest picture. Mr. Winders is justifiably proud of her



Clement Birch, Joliet, Ill., proved to his own satisfaction the theory that the brain works best around midnight. That is when he found most of the mistakes



"The Picture Contests," writes Carol Young Alwin from Minneapolis, Minn., "were an incentive in developing the power of observation." She is an artist

TURN TO PAGE 164 FOR THE COMPLETE LIST OF PRIZE WINNERS FOR JULY



# New Airplane Built Like a GULL

*Inventor Studied Long-Winged Birds to Find New Secrets of Power and Speed*



L. W. Bonney, inventor of the sea gull airplane, holding aloft the stuffed bird he used as a model. He caught and studied many gulls before picking this one as ideal in its proportions.



Left: The inventor in his still unfinished plane. Below, a rear view, showing the wings folded. This feature is designed to permit the plane to be landed in a back yard and then run into a garage.

**B**UILT like a sea gull in soaring flight, this remarkable

new type of airplane was designed by Leonard W. Bonney, of Flushing, N. Y., after a plaster cast of an actual bird. The wings, shaped like a gull's, can be folded back by pressing a hydraulic lever in the cockpit. At the instant the wheels touch the ground in landing, the wings are drawn back, placing the plane's entire weight on the wheels and enabling it, according to the theory, to be brought to rest within a few feet, even in a back yard. The ordinary plane must taxi across a landing field a considerable distance before it can stop.

Mr. Bonney's flying experience dates from 1910, when Orville Wright taught him to fly. Now 42 years old, he has been an aviation enthusiast ever since. For two years he studied the flight of birds,

convinced that aviation still had many secrets to learn from their methods. Deciding finally upon the sea gull as his model, he caught a large number of them, measuring their wing spread and the weight they could carry. One specimen which in every way measured up to his ideal requirements became the original pattern for the plane.

Swooping down to earth and landing with its wings folded, the *Bonney Gull*, as it is called, may be wheeled into an ordinary garage, so little space does it occupy in this position. Folded or extended, the wings are held rigidly in

position by gun locks. In flight, the machine is balanced and guided by the flexible wings, which will adjust themselves to keep it on an even keel. A supply of gasoline is carried in a tank fastened to the outside of the plane at the front of the fuselage, directly under the propeller.

Within the body, the cabin resembles the interior of a motor car. A seat for two passengers is covered with a streamline top that enhances the graceful lines of the remarkable craft.

## He'd Wrest Power from the Rise and Fall of Ocean Waves

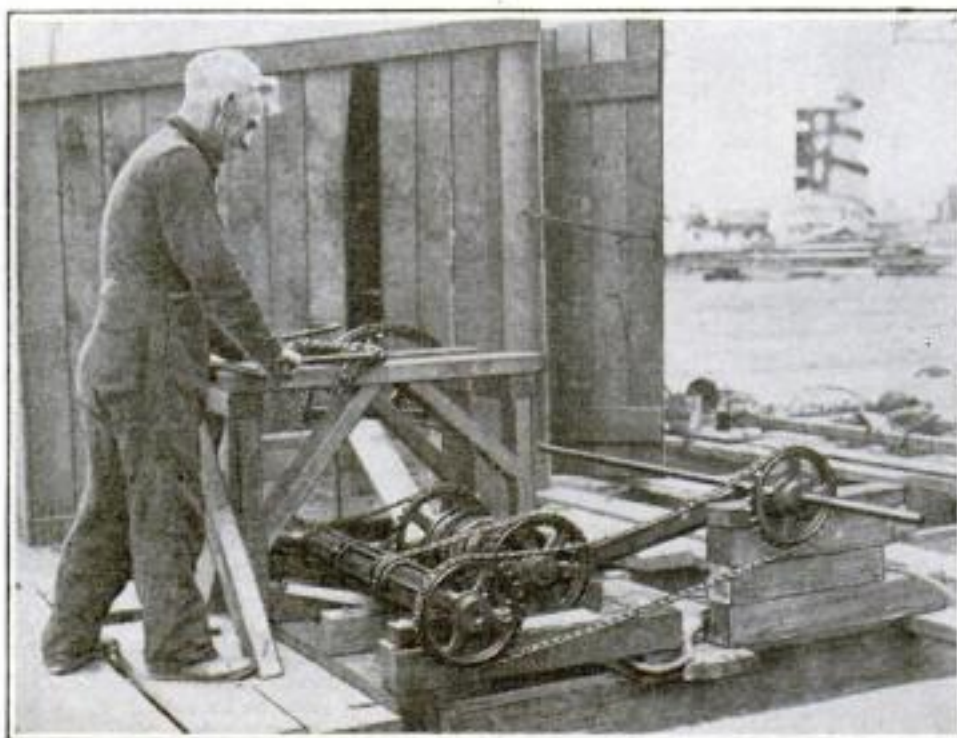
**M**ACHINES that would utilize the power in the up-and-down motion of ocean waves have long inspired inventors. One of the latest is the wave-harnessing machine illustrated here, and its inventor, Arthur T. Adams, of Los Angeles, Calif., is confident that a practical working type of it will make power as cheap as air or water. He has worked on the model pictured here for more than three years.

The working principle is a number of springs which are tightened by the constant up-and-down movement of floats placed upon the water. By operating the apparatus for five or six hours a day,

the inventor says, he stores up enough energy to run it for twenty-four hours. It can be used practically by ships at anchor, he declares, or to operate danger signals, buoys or lighthouses.

With a machine developed from his present model, Mr. Adams has undertaken to light up a pier now under construction at Venice, Calif.

The floats used are shown at the right.



Floats that tighten springs as they rise and fall with ocean waves are the basis of this unique "power generator." Left: A. T. Adams, the inventor, with the springs. Right: The type of floats used.



# Latest Arc Welding Feats Amaze Engineers

*Joints Made by New and Speediest Process  
Fail to Crack under Terrific Tests*

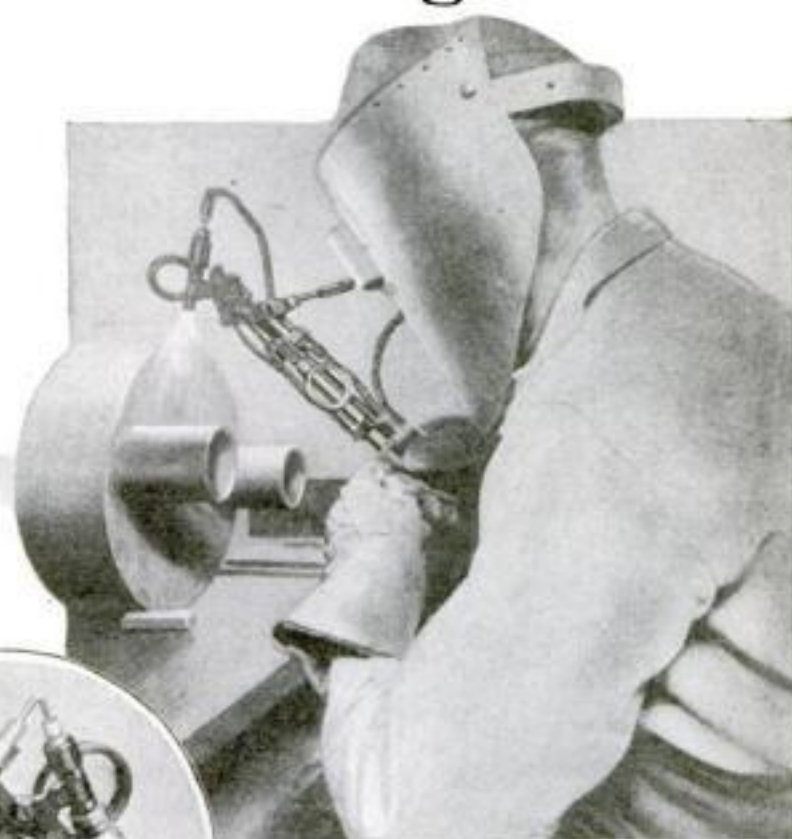
**T**HE new method of welding—by means of an atomic hydrogen flame rather than an oxy-hydrogen flame—is hailed generally as an important advance in this construction method, which lately has come to be regarded as the ideal substitute for the noisy riveting hammer.

Like many other important discoveries, this invention is the result of research in an entirely different field. Dr. Irving Langmuir found during laboratory investigations for the General Electric Company that two atoms of hydrogen gas, forming the more stable molecule, could be separated under high temperatures. When they combined again to form the molecule, intense heat was liberated.

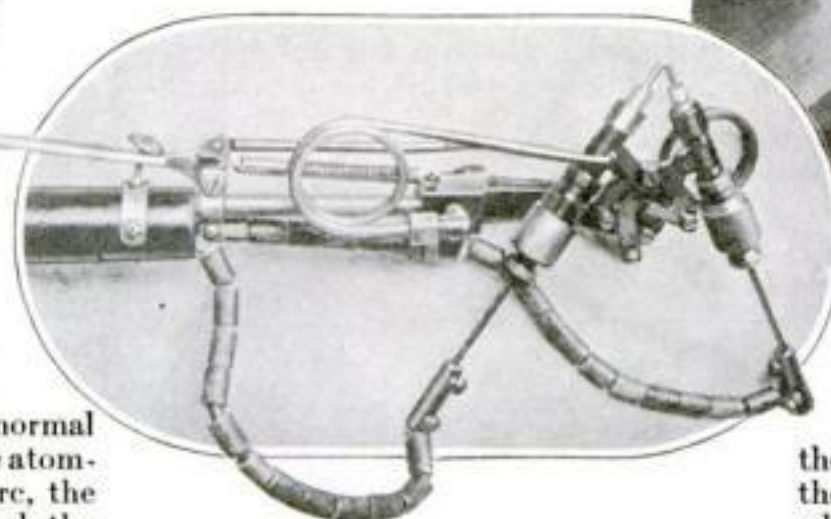
The utilization of this intense heat became the basis for the new welding apparatus. The hydrogen is reduced to the atomic state by passing a powerful electric arc between the two tungsten electrodes and directing a jet of the gas in its normal molecular state into the arc. As the atomic hydrogen is blown out of the arc, the atoms combine into molecules and the heat generated in this way greatly increases the temperature of the burning hydrogen. This heat is said to be fifty percent more intense than the oxy-hydrogen flame now in use for welding.



Above: Sample of welding, showing how metal welded by the new process does not crack when bent



Above: Welding a piece of casting by the new atomic hydrogen process. Left: Close-up of the torch, showing the two electrodes



The gas is supplied to the electrodes, which are in contact when not in use and are adjusted by a screw, through a tube in the handle under a pressure of less than a pound to the inch. In addition

to the gas supplied to the electrode tips, a quantity is ejected to surround the parts to be welded. This prevents the formation of oxide or nitride films which make the ordinary arc welded metals brittle.

Welds made by the new apparatus, it is said, do not crack or break under the twisting and bending tests, and are made far more rapidly.

## Magnetism Now Detects Rail Flaws That Caused Wrecks

**W**HILE defective rails are known to be responsible for disastrous railroad wrecks involving huge losses of life and property annually, until recently there was no means of detecting the hidden flaws in the rails, which caused these catastrophes.

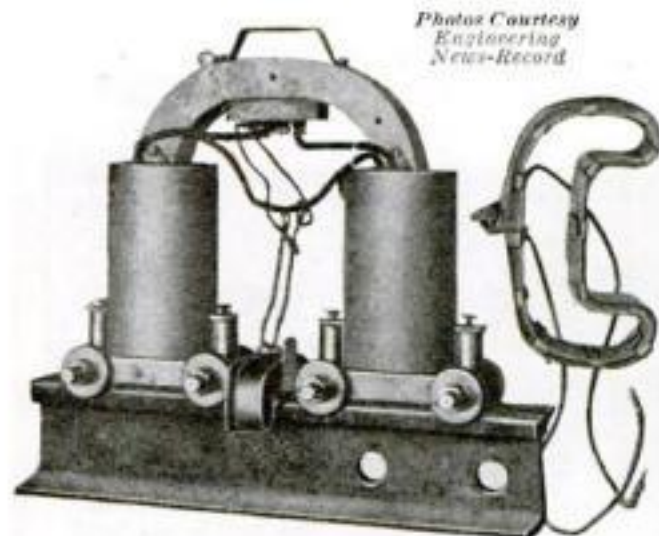
Now a Japanese engineer, M. Suzuki, brings forward an invention perfected in the laboratory of the Japanese Government Railways at Tokyo, to detect such internal defects as transverse fissures, segregation of impurities, and so on, in rails. The defectoscope, as it is called,

detects these flaws by magnetism. It consists of two parts: a powerful electromagnet which creates a magnetic flux in the section of rail under test; and an exploring coil, working on an entirely separate circuit, that records any variation in the magnetic flux. This is the brains of the apparatus.

So long as the flux remains constant, as it will in a perfect rail of uniform cross section and density, the exploring coil will

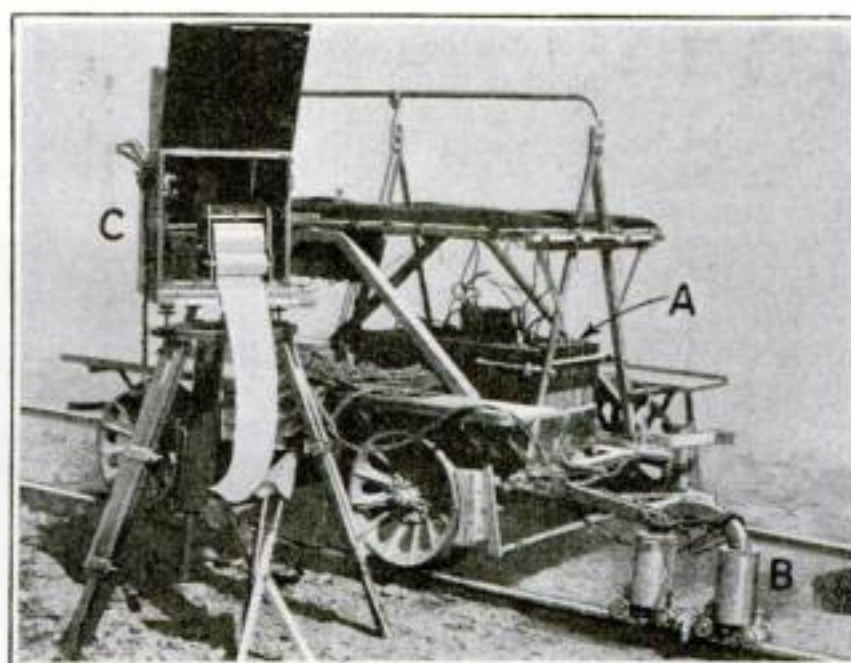
be electrically "dead" and will show no reading on the attached galvanometer, an electrical instrument for measuring minute electric currents. If a flaw is encountered as the magnet rolls along on its own wheels, the magnetic flux will suddenly drop and return to normal again, inducing a current in the exploring coil which the galvanometer records. In this way the slightest flaws may be detected before they become dangerous.

With this outfit about 100 rails can be tested in an hour.

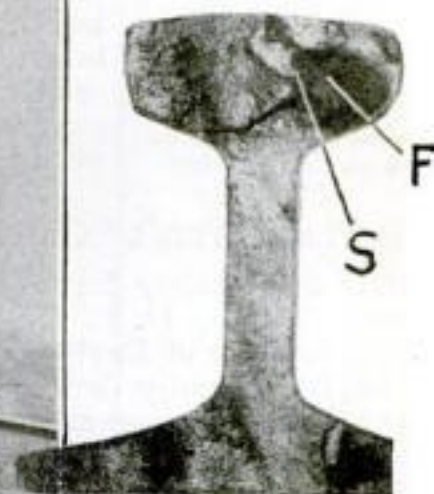


Photos Courtesy  
Engineering  
News-Record

How the electromagnet is placed by means of rollers on a rail to find hidden flaws. The exploring coil, between the poles of the magnet, is shown in enlarged view at the right



The defectoscope in action, mounted on its car and in position on railway tracks. Electromagnet B on the rail receives current from batteries A. C is the recording apparatus



Section of a rail, showing a bad split and transverse fissure. Hidden flaws can easily be detected by the defectoscope



## Ingenious "Gun" Splits Logs into Cordwood



Log-splitting gun, already in wide use in farming and lumbering regions of the Northwest

ANY large tree, after being felled and sawed into four-foot lengths, can be split up easily and quickly into cordwood by the use of a remarkable new instrument known as a splitting gun.

The "gun" resembles a heavy metal pin. The driving end is solid and the muzzle end, which is slightly tapered to facilitate driving, is hollow. About a teaspoonful of black blasting powder is poured into the hollow end, and after a fuse is fitted, the splitting gun is driven into the end of the log. The protruding rear end is supported against a heavy piece of wood.

Driving the gun into the log tightly compresses the powder, and when it is fired by means of the fuse the gas is driven forward and its expansive force blows the log into at least two pieces.

Ordinarily about two minutes are required, it is said, to load the gun, drive it and set it off.



### Umbrella Folds in Vanity Case

BEING overtaken by a sudden shower is no calamity to the woman whose vanity case is this latest novelty from Germany, shown above. Face powder, puff, and rouge rub elbows companionably with the handle and collapsible ribs of an umbrella. When folded, the umbrella fits compactly into the top of the case.

## New Folding Boat Seats Two Rowers

FOLDING boats have long been popular in Europe, where it is no uncommon sight to see them being carried from one to another of the many small rivers.

A new folding boat that can be easily dismantled and placed in boxes as small as those illustrated below, is the recent invention of Karl Steiner, a young German.



Left: Starting to put together the folding boat. The two boxes hold the entire boat, and the assembling is said to be the work of a few minutes. Above: The completed boat, light enough for a girl to hold aloft

### Forests Sown from Airplanes

TWO men scattering tree seeds over devastated land from an airplane can accomplish as much in one and a half hours as two men working on the ground could in ten years, according to an experiment conducted by the Army Air Corps in Hawaii. A large area devastated by fire, where seeding by hand was found impracticable, was replanted in this way.

Three trips were made over the burned area by an Army aviator, carrying twenty-four bags of seed.

### Musical Tree Plays Christmas Carols

CONSTANTLY revolving so that the tinsel glitters and shines, a Christmas tree set up in a recently invented musical tree holder sends forth tinkling Christmas carols, much like the old-fashioned music boxes. The holder plays twenty-five minutes without winding.



Holder will support a tree six feet in height

### His Plane Won't "Crack Up"

TWO novel safety features were incorporated by D. E. Dunlap, aeronautical engineer of Dayton, Ohio, in a new airplane recently designed by him. Two pusher type motors are used, placed at each side of the pilot, and the nose of the fuselage is rounded off, so that the plane will simply roll over instead of breaking up and crushing the pilot and passenger under the weight of the engine in case of a bad landing.

The phonograph photographed in comparison with a ten-inch record



### All That Makes a Phonograph—Less Than Two Inches High

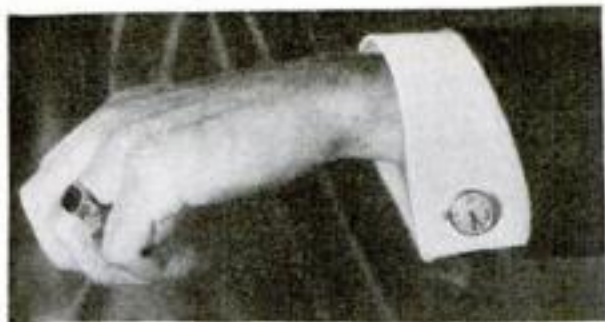
SMALL enough to be carried in a coat pocket, the remarkable little phonograph above is the product of an English factory. Its dimensions can be appreciated by comparison with the average size disk record shown. They are: diameter, four and one half inches; height, one and three quarter inches, and weight, two and three quarter pounds. In all essentials, it is said, the little instrument follows the construction principles of the ordinary talking machine.

### Building Stone from Brick Waste

BY A new process for making building stone from brick waste invented by two Swedish engineers, the waste bricks are first crushed to small lumps and sifted. The finer part is ground to a powder, mixed with lime or cement, and water added, making a mixture the consistency of a plastic mortar. To this is added the coarse material obtained from the first grinding of the bricks. The resulting mixture, when dry, is said to be an excellent substitute for natural stone.

AT A HOTEL in Berkhamstead, England, recently, twenty couples danced to music which could not be heard by the spectators. The music was broadcast from a near-by radio station, the dancers carrying their own radio receiving sets, equipped with small inconspicuous headphones.





### Cuff Link Watch the Latest Style in Timepieces

**T**HIS latest mode of wearing the watch has been introduced in Germany as a substitute for the wrist watch. It is a cuff link timepiece, and fairly accurate in spite of its diminutive size, it is claimed. One advantage it has over the wrist watch is that the shirt sleeve doesn't have to be drawn up part way to the elbow in order to see where the hands are pointing. The link on the other side is hinged, and folds flat against the connecting bar, to permit easy insertion through the button-holes.

### Searchlight Stops Auto Thefts

**P**OLICE officials of Worcester, Mass., recently announced that the number of automobile thefts in their city has been cut in half by the use of a huge 30-inch searchlight of 43,000,000 candlepower.

This light is placed on the top of a tall building, where it can be seen a long distance. Officers are instructed to watch for signals flashed by the light whenever a theft is reported, and to go at once to the nearest patrol box for details of the robbery. The light then is turned on the section of the city where the theft occurred, aiding in the capture of the criminal.

## Machine Shows "Dub" Golfers How to Putt

**B**ECAUSE so many golfers, even experts, are weak on the putting green, P. A. Vaile of Chicago, noted sports authority, has perfected a practicing machine which, he declares, forces one to go through the difficult putting stroke in perfect form. He also has devised new exercising apparatus to develop the golfer's muscular strength and control.

The putting machine, at the right, consists of an upright supporting a pivoted clamp that holds the tip of the shaft in such a way that the club, when gripped by the student, swings like a pendulum. The club also strikes the ball when the

shaft of the club is at right angles to the direction the ball should take. This, according to Vaile, is the only way to impart a true roll or "run" to the ball.

Other new apparatus includes special leverage dumb-bells (at the left), which are weighted to require unusually tight grip and so develop the wrist muscles, and a bar-bell (center) with an adjustable weight to develop shoulder and arm muscles.



New leverage dumb-bells are weighted to require a tight grip, strengthening wrist muscles



Above: Practicing the putting stroke with mechanical aid. At left: Developing arms and shoulders with weighted bar-bell

## Giant Camera Snaps a Whole City at Once

**D**ESIGNED for Army Air Service work, this huge aerial camera is being tested by Lieut. George W. Goddard at Dayton, Ohio. The lower end shown in the illustration houses the largest photographic lens of the high speed, anastigmatic type that has ever been ground. The image recorded on the film is nine inches square.

At an altitude of 35,000 feet, the lens would produce an image showing a city the size of Detroit to be about three and one half inches long.



Lieut. G. W. Goddard and W. Oswald with the huge camera

### Wire Splicer Designed for Telephone Linemen

**T**HE broken strands of telephone or other small wires can be spliced in a few moments, it is said, with an instrument invented by Niel Kjesbu of Silver Creek, Wash. A short piece of steel is drilled and grooved so as to catch the broken ends, which are then twisted into a splice. The inventor claims his device is adaptable to the needs of telephone linemen who have to work in awkward positions on the arms of telephone poles.

The splicer is slipped on to the line at the point where the broken strands are crossed and held, and one of the ends is caught in the groove. When the instrument is twisted, the broken end is firmly spliced. The operation is then repeated with the other broken end.

### Pipe "Tree" for Young Climbers

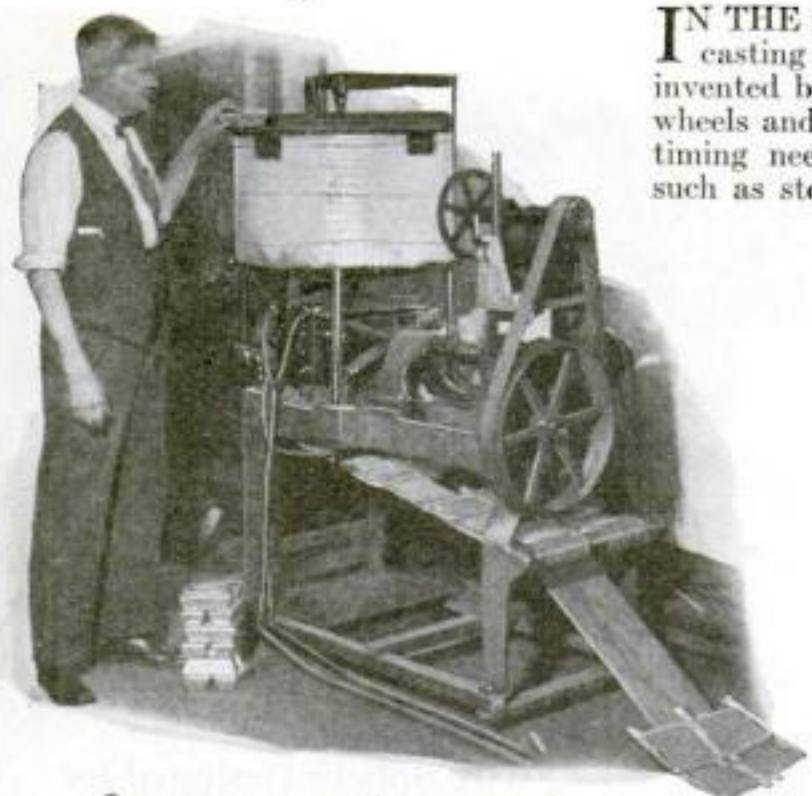
**T**HE play instinct in children usually demands satisfaction in climbing one thing or another. A tree naturally is the most tempting challenge. As a substitute, for back yards where no trees grow, a California manufacturer has devised the next best thing, which he calls a "climbing-tree." It is a framework of joined pipes formed with a central "trunk" and a series of "branches," one above the other. There is little danger of a fall, or torn dresses, or bruises. Guard rails protect the ends of the "branches."



"I HAVE COMPLETED six ship models described in the POPULAR SCIENCE MONTHLY Home Workshop. Four were Barbary pirate ships which I sold for an average of \$45 each, and two were Spanish galleons, sold for \$125 each.—W. J. HAZLEWOOD, TOLEDO, OHIO.



## Automatic Die Caster for Small Lead Parts



One man can operate three or more of these machines with very little effort

**I**N THE remarkable new automatic die casting machine pictured at the left, invented by R. H. Williams, of Detroit, wheels and gears are substituted for the timing needed to produce die castings such as storage battery grids and other small lead articles.

Molten lead flows through a valve controlled by the timing mechanism. After the die is filled it is kept closed long enough for the lead to harden, and then opened. The battery grid is ejected from the die and carried out of the machine by a moving belt which stacks the grids in an orderly pile. The timing control then closes the die and the operation is repeated as long as pig lead is fed into the melting tank.

Because no attention is required except the feeding of the lead, it is possible for one operator to take care of several machines.

The machine is geared to make two hundred operations an hour.

### Pocket Lamp Held Like Cigar

**H**ELD easily in the mouth and switched off and on by the lips, this handy little pocket lamp leaves both hands free to work with. The battery for it is carried in a vest pocket. It is especially practical in fine work for which a direct beam is needed, or for work which must be done in darkened rooms, such as photographic developing. It was invented recently in Germany.



As a dark room lamp for photographic work



Left, walnuts branded for identification. Above, the new stamping machine

### Brands 2,000 Walnuts a Minute

**C**ALIFORNIA grows more than ninety-eight percent of all the walnuts grown in the United States, and the problem of branding these millions of nuts to identify them from all others has long perplexed the nut growers. Recently the machine above was selected from 900 devices submitted in competition.

The nuts are stamped with printer's ink as they pass under the sponge rubber dies on a revolving cylinder. The cups on the cylinder are large enough to hold all sizes of nuts. The stamps are inked with each revolution from a roller above the cylinder. Sponge rubber dies accommodate themselves to the size of the nut, and the stamping pressure is light enough to make a legible imprint without cracking the shell. It prints 2,000 nuts a minute.

A NEW SOURCE of paper is shortly to be exploited in Northern India—bamboo. Extensive tests have shown the feasibility of converting bamboo into paper pulp by treatment first with sulphate of soda, giving unbleached pulp; then with bleaching powder, producing finished pulp.

### How Much Do You Know of the World You Live In?

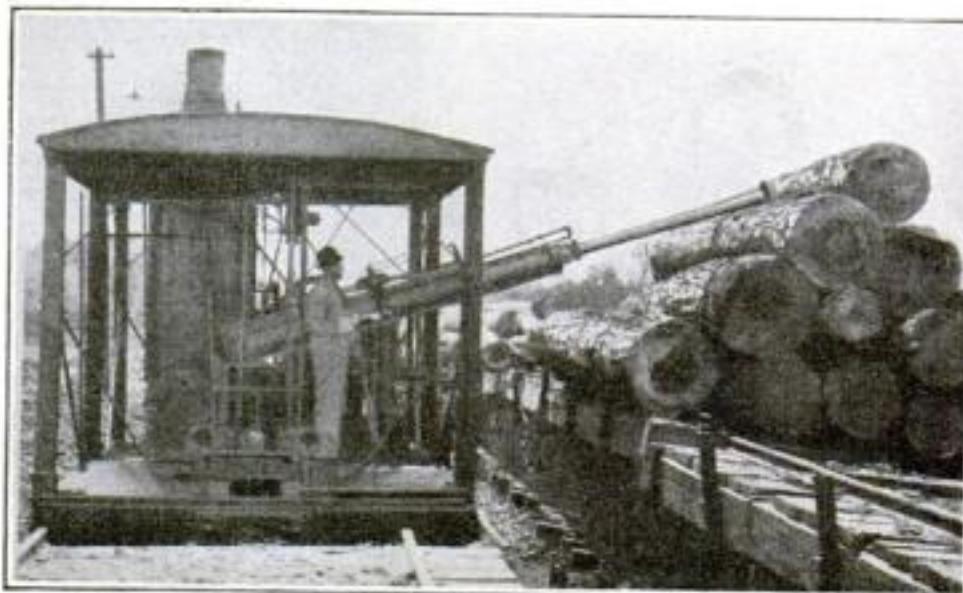
**Y**OU know more than the average, if you can answer more than half of the following twelve questions selected from hundreds of queries sent in by readers of POPULAR SCIENCE MONTHLY. The correct answers appear on page 165.

1. Where are there oil wells underneath the sea?
2. Where is the center of population of the United States?
3. What place in the United States has the longest days?
4. What are the floating gardens of Mexico?
5. How fast does the Gulf Stream flow?
6. Which continent has been least explored?
7. What is the Tower of London?
8. Where are messages sent by drumbeats?
9. Where are the speaking statues?
10. Where do people eat earth?
11. Where did kings wear feather cloaks that took a hundred years to make?
12. Where do ferns grow as tall as trees?

### Mechanical Arm Unloads Logs from Cars

**T**O UNLOAD logs from railway cars into the mill pond, the ingenious steam-operated machine below was invented by M. F. Crawford, of Natalbany, La., where it was recently placed into service by a Louisiana lumber company. The work of unloading the heavy logs from the cars which brought them from the lumber camps into the mill pond formerly was done by men equipped with prying hooks. By that method, there was always a constant danger of crushing or maiming.

This unloader consists of a cylinder extending ten feet from the engine on a track parallel to the loaded car. The hook at the end of the extension rolls the log forward off the load at a single stroke.



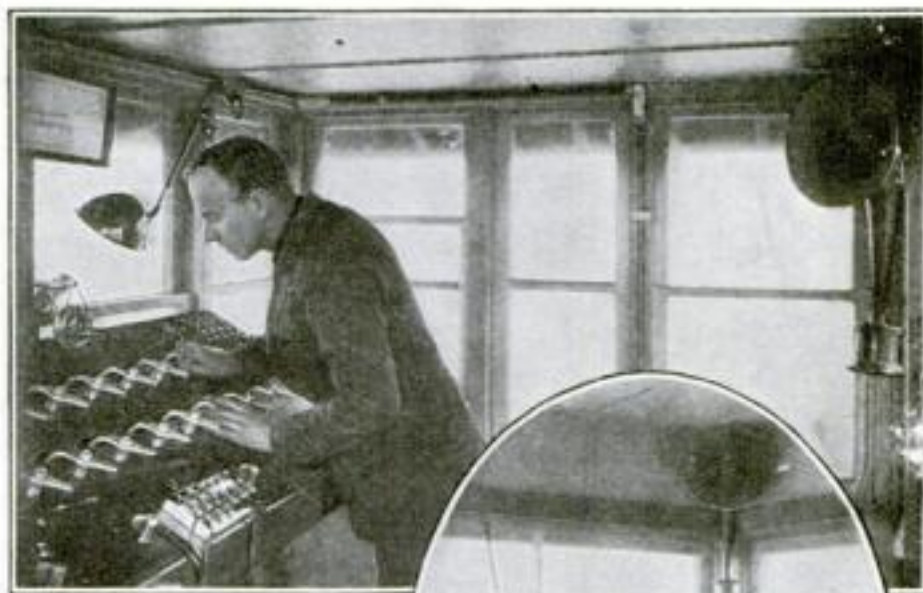
Extension hook pushing the logs off a car into the mill pond



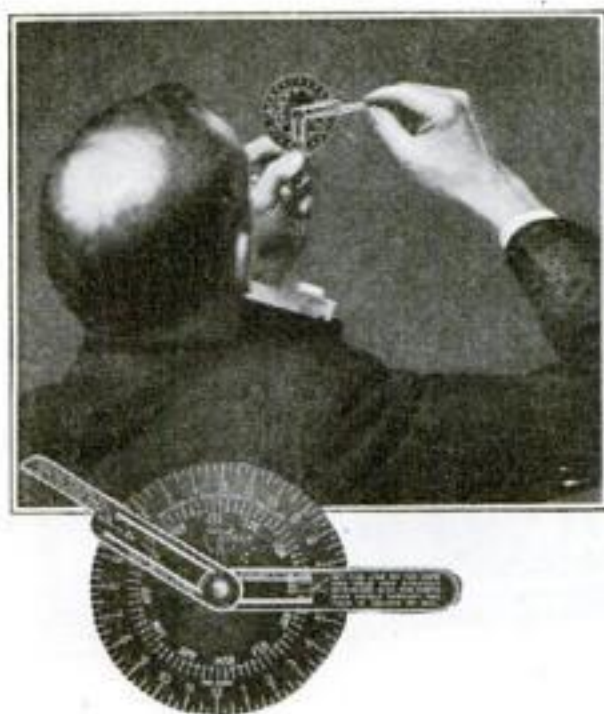
## Yardmaster Directs Switchmen by Radio

**F**ROM his watch-tower the railroad yardmaster is lord of all he surveys. Not only can he see the full stretches of his kingdom, but through a new application of radio he can now direct men in its furthest domains with his own voice.

With the completion of its new yards, the Illinois Central Railroad at Chicago installed a radio microphone in the yardmaster's tower. An amplifying system of eleven loudspeaker units and as many microphones is scattered about in the yards. Instead of sending orders to switchmen by means of runners, the yardmaster now sits at his desk and gives them over the radio. His voice as he issues orders is amplified many times over, and his directions reach the ears of the men loud and clear.



Switchman, above, receiving through loudspeaker orders from yardmaster, at right



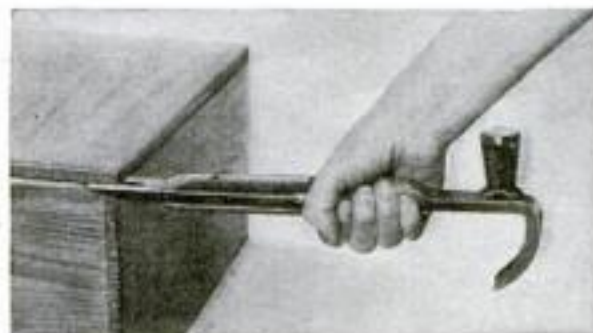
### Odd "Watch" Tells Time by Stars

**W**HILE the fact that the stars apparently revolve about the North Star is known to nearly everyone, it remained for Frederick C. Meacham, of Garden City, N. Y., to work out a simple way to link up this "motion" with the hours of our time system.

As shown in the illustration above, Meacham's device consists of a thin disk in the center of which are pivoted two pointers. On the inner circle of the disk are printed the months and days and on the edge the hours of the clock.

To tell time by the stars, one of the levers is set to the day of the month. Then, with this lever pointing directly at the ground, the disk is held a few inches from the eye in such a way that the North Star can be seen through the center. Then the other pointer is moved around so that it apparently touches the two stars that form the side of the bowl of the dipper opposite the handle. If the observation is carefully made, the pointer will indicate the exact time.

A RADIUM-BEARING ore vein of considerable size and value was reported discovered recently near the old Tuya-Muyun mines in Turkestan, Asiatic Russia.



### It's Hammer and Wedge in One

**H**ANDY for opening boxes and other uses around the house is the combination hammer and wedge above. The shape of the claws makes it possible to lift a nail straight up. Its construction—solid steel from end to end—gives strength necessary for hard prying strains.

## Motorcycle Driven by Airplane Propeller Blade

**A**NOTHER variant of the airplane-propeller-driven vehicle, invented by John Stout, of Zion City, Ill., is pictured below. The engine, though small, spins the propeller at a rate that makes fifty miles an hour an easy speed for this motorcyclist to attain. The simple and open construction of the chassis reduces wind resistance to a minimum. Details

of the construction are shown clearly in the illustration, and need no explaining.



For speed on land as well as in the air, the airplane propeller is finding many uses. Here's the latest

### Chemists Wear Glass Uniforms

**P**LATE glass overalls, masks and gloves have been designed to protect chemical workers who handle acids, powders, and other corrosive and inflammable materials. Binding together the material with copper wire insures flexibility.

## Know Your Car

**T**ESTS have shown that balloon tires as they are now made will give as good service as the high pressure cord tires, but long mileage can be obtained only if care is taken to keep them up to the proper pressure.

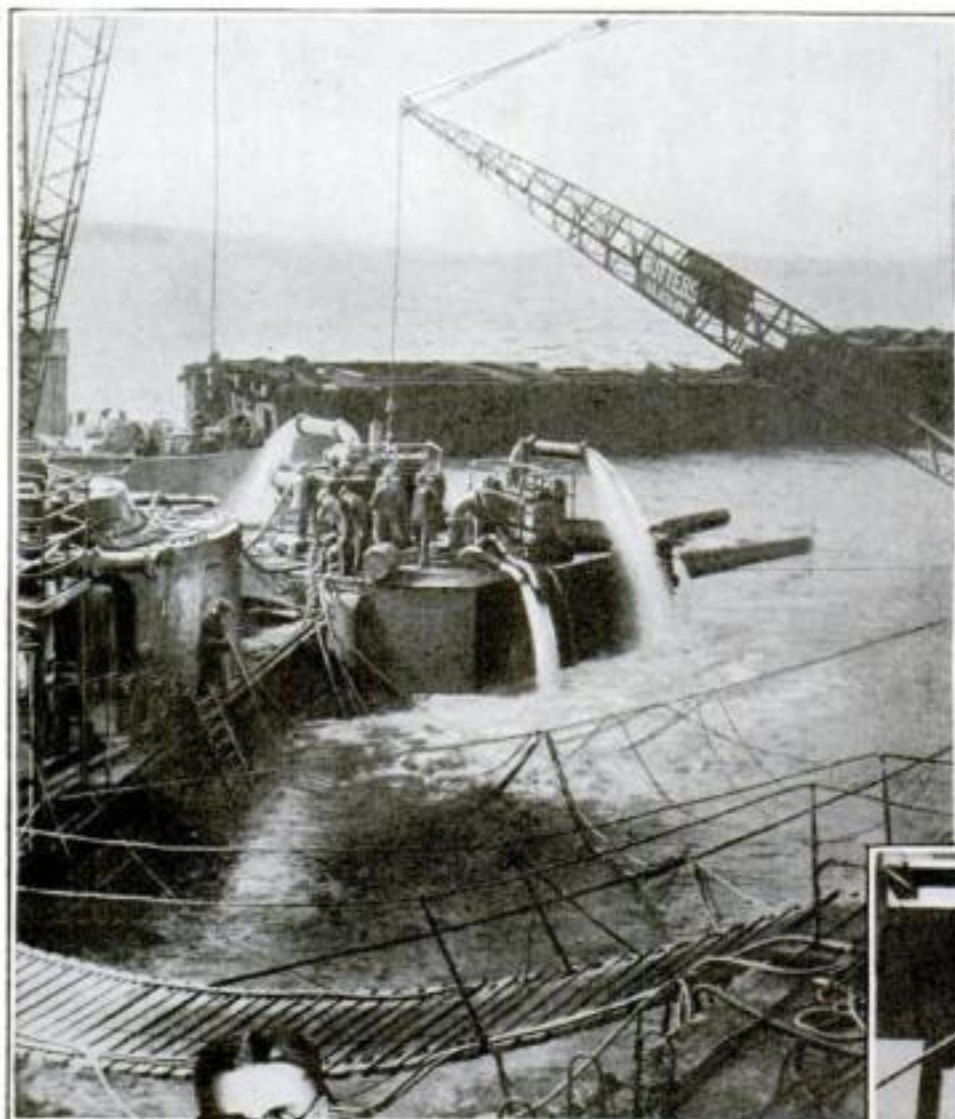
All auto tires gradually lose the air that is pumped into them. The rate of leakage usually is faster in hot weather than in cold. Most motorists are in the habit of pumping their tires up to the recommended pressure and then letting them alone until they see the tire getting flat. A better plan is to pump up the tires at regular intervals of once a week in summer and once every two weeks in winter. Put in a few more pounds than recommended, so that by the end of the period the tires will have dropped only a pound or two below the proper pressure. Watch these points:

1. Pump your tires at regular intervals.
2. Always pump in three or four pounds more than recommended.
3. Make sure that your front wheels line-up properly.
4. Use your brakes as little as possible.
5. Keep away from curbstones.



### Raising What the Germans Scuttled

The German warship *Hindenburg* was brought to the surface recently from the bed of Scapa Flow, Scotland. The photo below shows huge pumps drawing the water from the hull. The ship was scuttled by its own crew six years ago, after the surrender of the German fleet



She Moves  
in Artistic  
Circles

Artists occasionally do have practical ideas, as this English girl painter proved. She had her bungalow studio constructed to revolve in a circle, so she would always have the best light

## The Uncommon



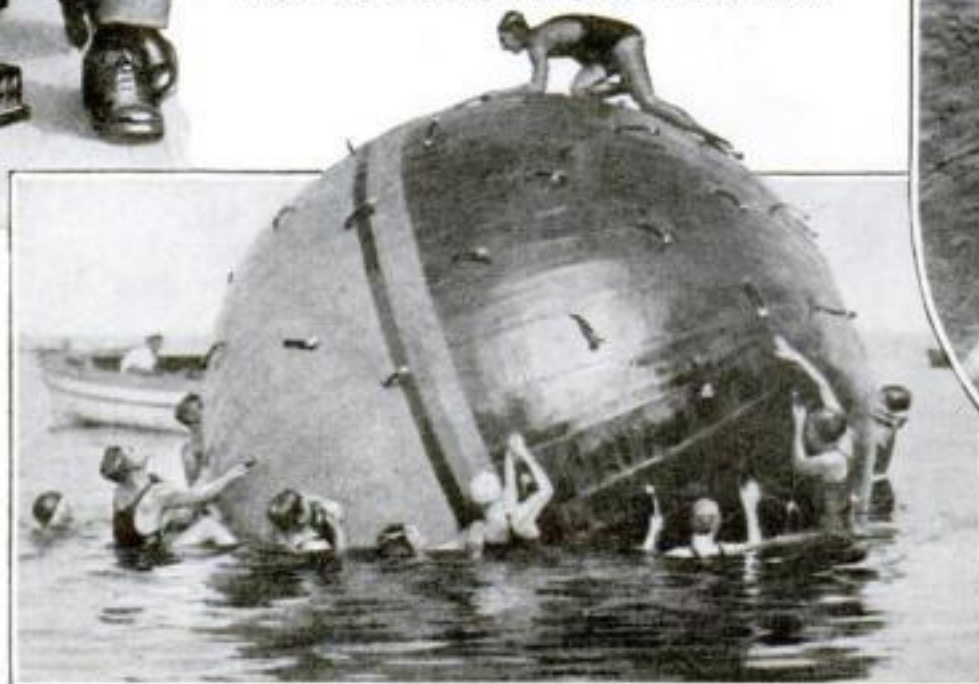
### Enter—the Human Airplane

Wings and tail attached to the body of the daring diver at the right enable him to soar like a bird over the heads of other swimmers. The dive was a spectacular feature of a Gymkhana held by the Jersey Swimming Club



### The Newest Ball Game

A huge ball, painted half red and half green, floats in the water. Splashing around it, seizing the handholds that cover it, are two teams, each team striving to raise its own colored half of the ball above the water. This, as pictured below, is one of the latest aquatic sports from California



### Patience on a Pedestal

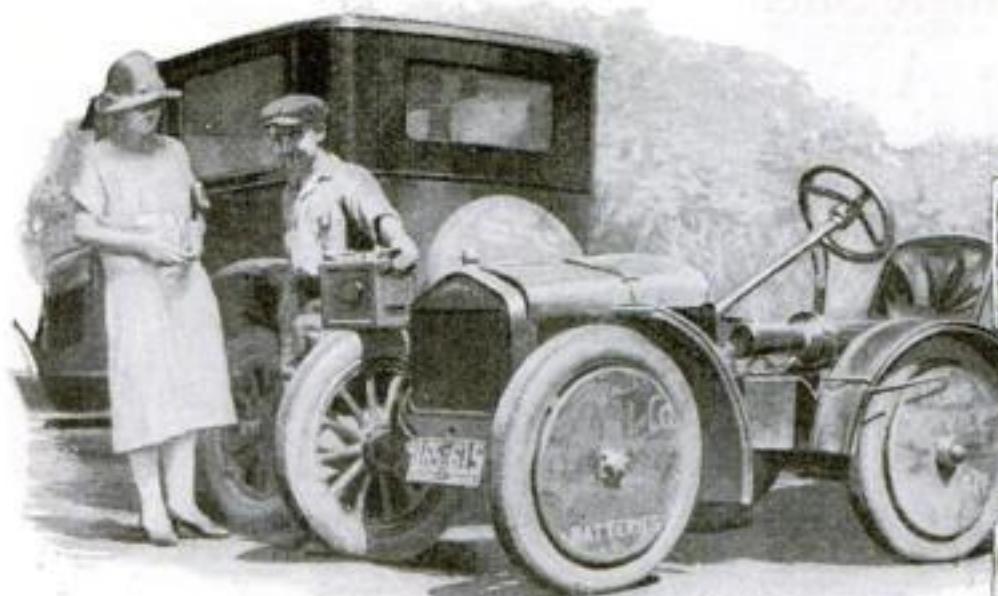
Anyone can produce a masterpiece of craftsmanship if he puts his soul and patience into it, thinks Homer D. Notestine, of Lewistown, O. He is shown above with the pedestal he made by piecing together some 2400 bits of oak, ash, walnut and wild cherry



### A Whale of a Surf Board

No commonplace board for this dare-devil aquaplanist, above! He is balanced precariously on a 45-ton whale which, caught off Los Angeles, is being towed in to port





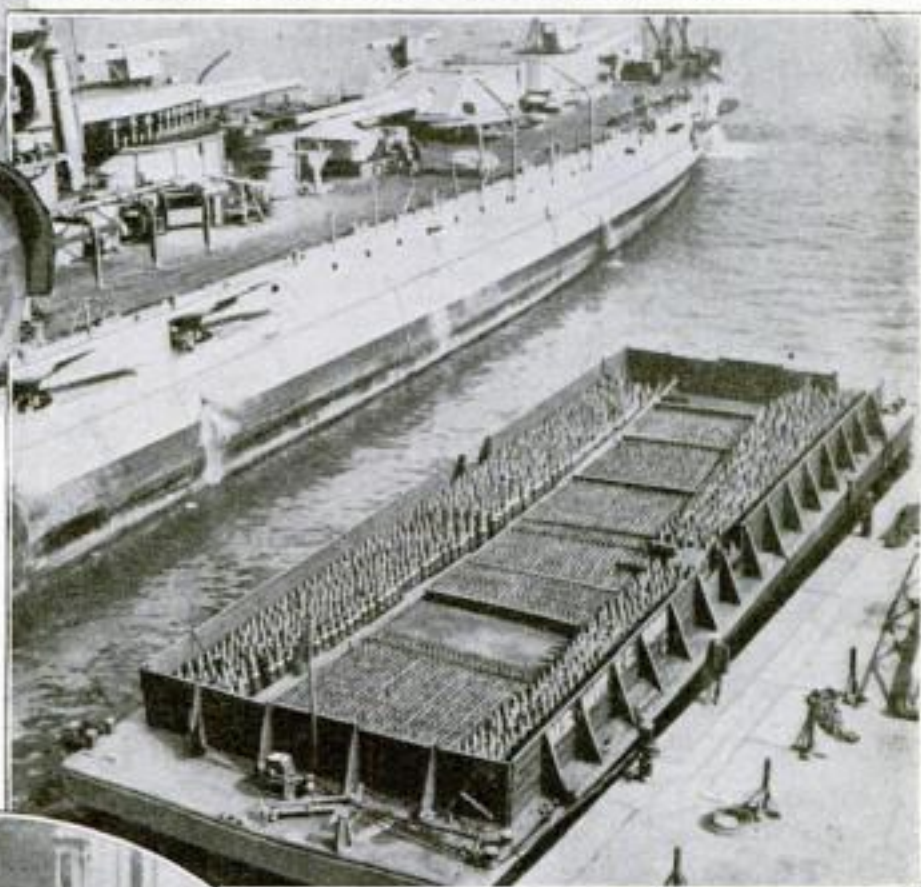
### Going Ford One Better

By knocking down a new Ford and cutting it up in all directions, an ingenious service station man of Knoxville, Tenn., reconstructed this handy service car. It slips through traffic jams like an eel among fish

## Run of Things

### What's in One Warship's Magazine

Grim messengers of death, stacked row on row, waiting for the "next war"—the shells loaded on the barge below were the ammunition of one single warship, the U. S. S. *Utah*. They have been removed pending alterations on the ship in progress at the Charlestown Navy Yard



### Caught in the Act

When the walls of a hotel at Long Beach, N.Y., collapsed the other day, a photographer on the spot whipped out his camera. The result was the extraordinary photo above, showing the wall at the moment it crashed

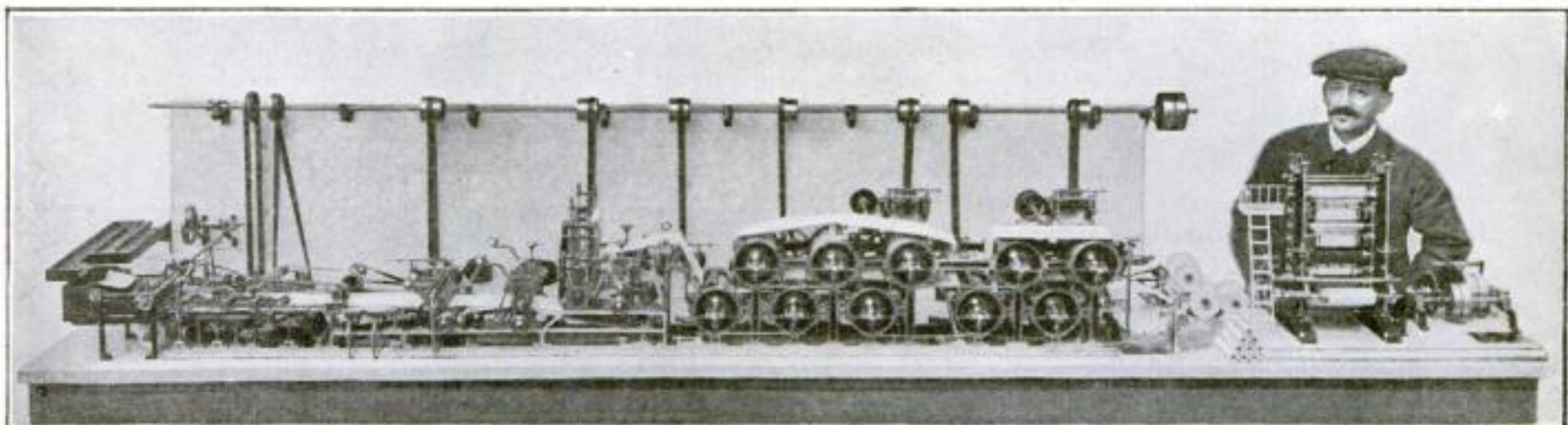


### Built in Half a Week

The house above was built in three and one half days, in merry England. Forty-two men built it, not a carpenter among them—most of them were clerks. This stunt was a demonstration to show how quickly and easily this new type of concrete house could be put up, even by amateur builders

### Mirrors Warn Motorists

Here's a traffic cop whose job is a sinecure. The mirrors below are installed where three roads intersect at Ashford, England. An approaching driver can tell by looking in them if the crossroads are clear



### It's a Paper Mill and Makes Real Paper

Actual paper four inches wide comes off the last rollers of the miniature paper mill above, made in France. Students in France often take special courses in paper manufacturing, which is a chief industry of the country.

A mechanic spent twelve years making this model, which measures about ten feet in length and received a medal at the Lyons exposition. Each of its tiny parts works as smoothly as those on a machine of regular size



## Famous Oarsman Invents New Single Shell



C. S. Titus, former rowing champion, exhibiting his new shell equipped with sliding foot rests and oarlocks. The seat is stationary

A NEW type of rowing shell in which the usual sliding seat is made stationary, the foot rests and oarlocks sliding instead, has just been designed by C. S. Titus, of New York City, once a champion oarsman.

Titus contends that the sliding of the seat shifts the full weight of the rower's body so as to interrupt the smooth progress of the shell. With sliding foot rests and oarlocks, on the other hand, only the weight of the rower's legs is shifted.



## Cycle Side Car Made from a Wrecked Toy Auto

TAKE the chassis of that wrecked toy automobile you bought for your youngster last Christmas, attach a spring or two, and a cycle wheel, then fasten it to a bicycle, and you have an ingenious side car vehicle, says William Sill, of Cleveland, who made the one illustrated here for his two little girls.

The bicycle requires some remodeling in order to accommodate the side car, and there's quite a bit of work to it; but, take it from Dorothy and Ruth, above, it's worth it!

## New Movie Camera Records Sea Wonders

A PICTORIAL record of under-sea life off the Florida coast is being made by Dr. Paul Bartsch, curator of mollusks at the National Museum at Washington, by means of a new motion picture camera constructed under his direction. It is water-tight, and can be regulated as to speed, or focus, as readily as on land. The tripod holds it steady against the action of the water.

Olive oil and a diver's helmet are all that Dr. Bartsch needs in his work at the bottom of the sea. Hitherto, pictures of this kind had to be obtained through elaborately furnished diving bells or glass-windowed chambers which were let down from chartered ships. This method proved too costly for extensive work. With his body greased, and air supplied to his helmet from pumps above, Dr. Bartsch expects to be able to work five hours under water at a stretch, at depths ranging from ten to thirty-five feet.



Dr. Paul Bartsch, of the National Museum, loading his new submarine movie camera

## Detects Factory Shocks

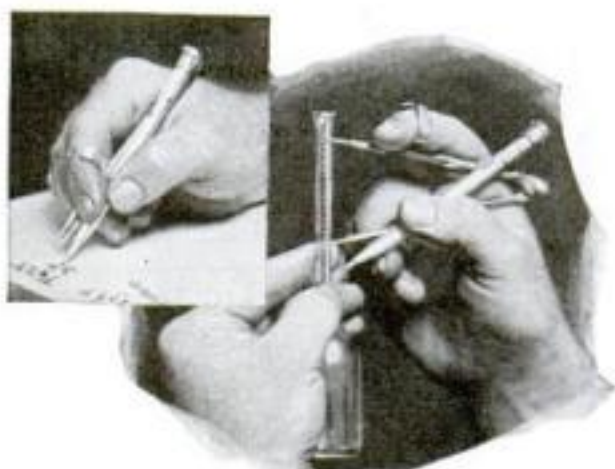
AN ENORMOUS seismograph recently constructed by Dr. E. Rothe at Strassburg, now part of France, is so sensitive that it records quivers in the earth caused by machinery in factories more than a mile away. The instrument, which weighs nineteen tons, magnifies earth vibrations two thousand times.

## Auto Awnings the Latest

ADJUSTABLE awnings that protect passengers from sun and rain are a novelty in automobile accessories. Rigid construction stops rattling or flapping, the maker claims. They swing with the doors and are attached quickly.



A closed car equipped with the new removable awnings



## Dividers and Pencil Combined

THE combined dividers and pencil shown above make it possible for the user to take his results and record them in a note book immediately without removing the instrument from his hand. Each leg of the dividers carries clips for supporting a pencil, while one of the legs carries a larger clip to receive the forefinger of the user. The device is the invention of F. L. Sorensen, of Fairmont, Minn.





### Ballroom "Clock" Beats Time for Dancers

**D**ANCERS and orchestra can keep perfect time with the dance speedometer pictured above, a new ballroom novelty consisting of two dials for counting the beats and indicating the correct rhythm. As the pendulum swings, a small hammer taps the little drum underneath, so the musicians can follow the correct time by eye as well as by ear.

### A Concrete That's Like Coral

**"G**ASSING" concrete to give it added lightness is a novel idea recently reported from Sweden.

While the concrete, a mixture of sand, gravel and cement, is still soft, gas is introduced into the mixture. This has the same effect on the concrete as yeast has on bread, filling it with small holes. The concrete so produced, it is said, is just as strong as the ordinary product, but much lighter, requiring less steel to support it.

## Planes Need Traffic Cops at Berlin

**C**ONGESTION of the air at the Berlin terminus of European air lines has reached such a stage that it is necessary to station men to direct traffic at the landing and take-off points. These aerial traffic cops are equipped with standards and flags to signal and direct the planes and to prevent accidents.

The photograph at the left, taken at the Central Air Port in Berlin, shows an officer holding up other traffic to give a plane a clear right of way for departure. The two other cops are stationed at a starting flag giving the signal for a landing. Though operating now on a gigantic scale, the Berlin air port amazes visitors with the clocklike precision with which the arrivals and departures are managed. Airplanes are constantly landing or departing—for Paris, for Poland, for the South. Hours are rigidly fixed and strictly adhered to. The place hums like a beehive, with all the pleasant excitement and bustle of a great railroad terminal.

Below: Traffic cop at the Central Air Port near Berlin, clearing the way for a take-off. Right: Cops directing a landing



With clocklike precision, a new kind of traffic officer directs arrivals and departures at this great German air station. We may soon see similar stations in America, with the launching of our great new commercial aviation program

## Piece of Cork Inflates Life Belt Automatically

**A** LIFE-SAVING belt that goes into action automatically when the swimmer gets into trouble is a new invention recently reported from Austria—the creation of two Viennese mechanics. The belt remains deflated until the actual emergency arises, when it inflates, bringing the person to the surface, it is said, within ten seconds.

This is accomplished by means of a cork attached to a rod which governs a valve. When the swimmer sinks, the cork is drawn upward to the surface, lifting the valve. Air is thus released from the container, where it is compressed, into the rubber belt.

The device is light in weight and is designed so as not to interfere with freedom of movement in swimming.



The life belt inflated. Ordinarily it is worn collapsed, permitting freedom of movement



### Slot Machine Sells Clean Towels

**D**ROPPING a coin in the slot and receiving a towel is the newest adaptation, recently patented, of the familiar vending machine. The coin releases the shaft about which the towel is rolled, and a clean length may be withdrawn.

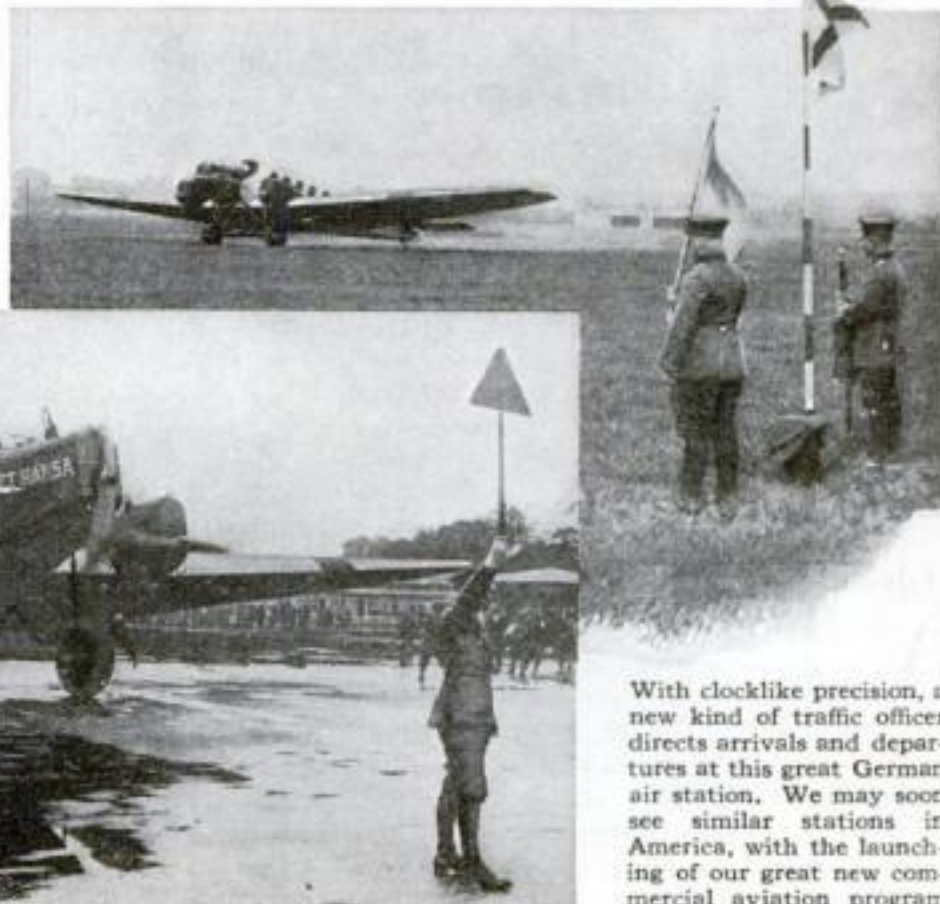
The shaft is normally held in position by a counterweighted locking lever, preventing the withdrawal of a towel. When a coin is inserted through the usual slot, it falls into a box on the locking lever, which is thereby rocked to release the roller shaft. A catch prevents the roller from turning more than the length of the towel until a new coin has been inserted.

### Lamp Exposes Counterfeits

**P**ICTURED above is the remarkable quartz lamp recently invented in Germany, the powerful ultra-violet rays of which are said to reveal fakes and forgeries in paper and fabric. The light exposes differences of color and texture, it is said, and is being used, as shown above, particularly for the detection of forgeries and counterfeits.

### Pipe Joints Made of Rubber

**O**NE of the most remarkable recent applications of rubber is the manufacture in England of flexible pipe joints. These rubber joints are being used for pipes carrying water, oil, gas, and so on, their chemically resistant properties giving them, it is said, special advantages. The pipes are joined by rubber rings, making a tight, flexible joint.







Dr. W. W. Coblentz of the Bureau of Standards showing the new glass screen

### Wall Paper Removed As Easily As Peeling a Banana

SEVERAL seasons' accumulation of wall paper layers in an average-size room peel off like magic in the space of two and one half hours, according to the makers of the wall paper removing machine shown in operation at the right.

It works by steam. A steel plate is pressed against the paper, and steam penetrates the layers through its perforated surface, loosening the paper so that it can be scraped off with a knife. At the same time the fine needle-spray of steam is said to eliminate dust and kill germs. The process leaves the plaster clean for immediate repapering.

The steam is generated in a steel boiler and raised to an eight-pound pressure with kerosene as fuel, the kerosene being kept in a copper tank said to be proof against fire or explosion. For ceiling work, a special device fits around the waist and over the shoulder of the operator to save him from back and shoulder strain.

## New Glass Protects Movie Actors' Eyes

MOVIE actors and actresses need no longer fear "Kleig eyes" from the powerful studio lights, it is reported. Bureau of Standards experts have developed a remarkable new glass said to protect the eyes from harmful ultra-violet rays, such as are radiated from the movie studio arc lamps.

Dr. W. W. Coblentz of the Bureau is shown at the left with the new glass screen, which will shade the lights. The glass contains cerium oxide, an element said to absorb the harmful rays without affecting the power of the light.

In order to make use of the new screen, a slight change will have to be made in the light itself. The carbon electrodes in the arc lamp will have to be white or yellow flame producers, and the photographic films will have to be sensitized to the yellow and red rays.



### Blue Coloring Matter Made from Old Pots and Pans

OLD iron utensils have been of little use except as junk until a new method of using them to make a blue pigment of high commercial value was discovered in England.

The old iron is thrown into a tank of sulphuric acid, which converts it into sulphate of iron after treatment in another tank. The final solution results in a blue pigment, which is used to make newsprint paper white and ink an intense black.

The photograph above shows the iron in one stage of its conversion, when it is turned into wonderfully formed, yellow colored crystals of prussiate of potash, which adhere to strings dipped in the tank.



Steam spray penetrating the thick layers loosens the wall paper from the plaster

### Vanity Case Banks Milady's Pennies



Powder puff, rouge, mirror, and small change

IN THE lid of the vanity case at the left is the usual square mirror, and the compartment for powder and puff is also of conventional design. But the

maker has ingeniously found room for a small coin bank, shaped so it will fold into the limited amount of space—thus loading one more duty on this already overworked article.

### Clock Operates Electric Switch

A CLOCK-DRIVEN switch to control electric current, shutting it off or turning it on at any predetermined time, is the invention of H. F. Schoenman, president of an Eastern firm of manufacturing jewelers. The switch contains a mercury-filled tube actuated by a clock. Rocking the tube causes the mercury to flow to one end and close the circuit.

HOT SPRINGS that exist in great numbers under the city of Budapest, Hungary, are being used for the first time, experimentally, to heat the city's buildings.

## Canoeists Use Airplane Propeller and Pontoons

ONCE it was a canoe, but since it acquired a motorcycle engine, an airplane propeller and a half-dozen pontoons, the odd-looking craft below has had a tough time trying to identify itself. However, it is meant

"for speed only," its ingenious inventors, O. L. Swanson and Herman Linne-

mann, of Peoria, Ill., claiming a speed of fifty miles an hour in their novel craft. The six pontoons, three on each side, are designed to keep the boat from turning over on sharp turns or in rough water.

With its lightness and the shallowness of its draft, the canoe can navigate rivers not practical for the motor boat, its inventors say. The canoe measures sixteen feet, and the motor has 25 horsepower.



The two inventors in their ingenious craft. Pontoons make short turns possible

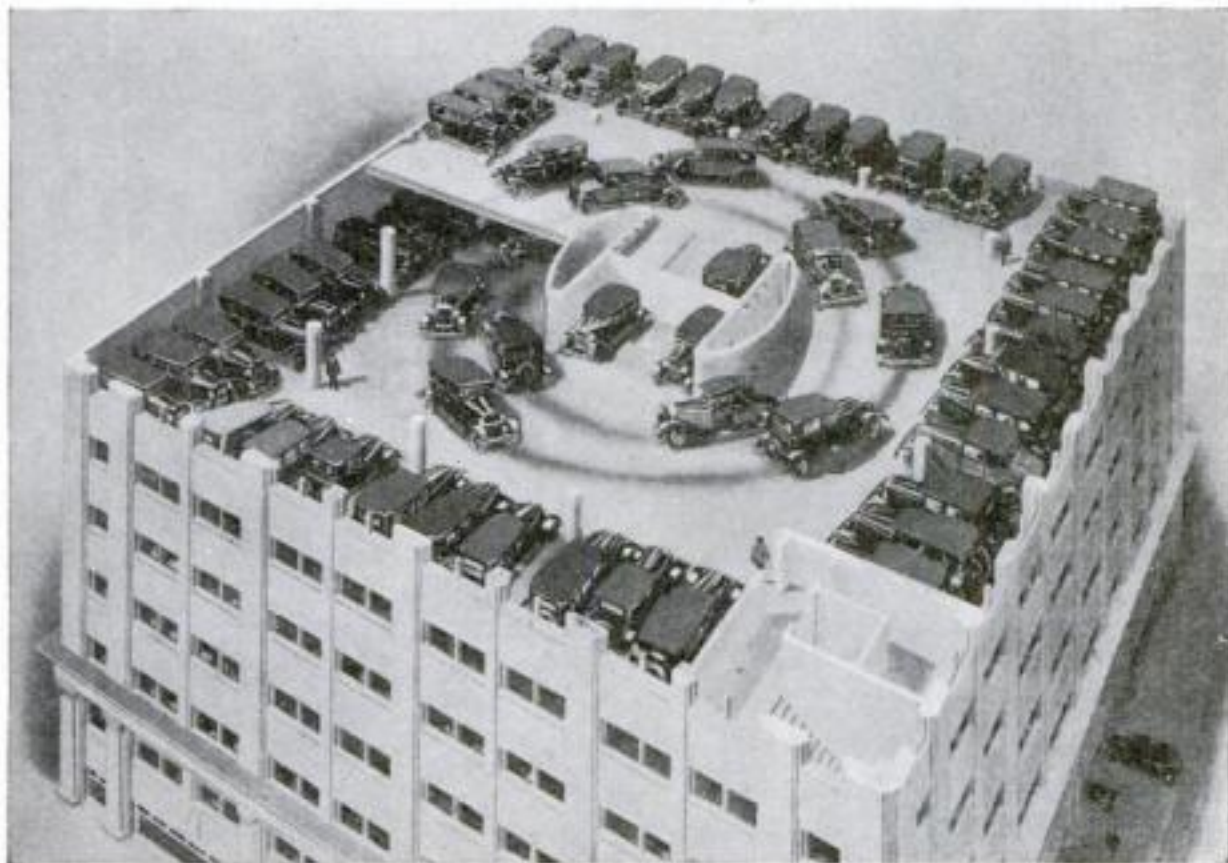


## Spiral Garage May Solve Our Parking Problem

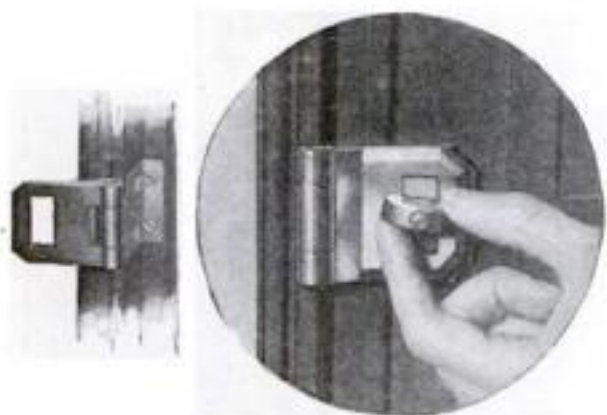
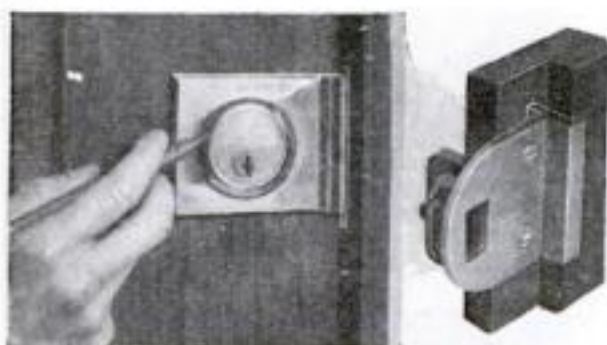
**T**O RELIEVE the congestion caused by parked automobiles that has become a serious problem in large cities, Samuel C. Lancaster and C. O. Hjermstad, of Chicago, have worked out a novel way to build a garage that could conveniently park a tremendous number of cars.

Instead of building the floors level and then using elevators to lift the cars from the street to the various floors, the new garage would have a floor in a continuous spiral from the street to the top floor. The cars would climb around and around the spiral under their own power and coast down.

A ten-story garage built according to their plans, the inventors say, would house over 500 cars if erected on a plot 115 feet square. This would be equivalent to the parking space along both sides of a city street sixteen blocks long.



Plan of the proposed spiral garage, showing how the double driveway would allow free and easy movement of cars, on their own power going up and coasting down. Such a garage, it is said, could be emptied in seventeen minutes, as compared with five hours for the lift type



Above: Hasp and escutcheon plate of the new lock. Below: Inside door-bolting device

A NEW ELECTRIC prospecting instrument is being used by the Ontario Department of Mines to indicate the presence of gold deposits—not so much to locate new veins, however, as to survey known areas.

### Locks That Foil the House Thief

**T**WO new styles of locks said to be virtually burglar proof have been designed recently by a New York inventor. The hasp, as shown in the upper illustration at the left, has a flange that is mortised into the door jamb so that it would be impossible to rip out this plate without practically destroying the door. The escutcheon plate of the lock is designed with a raised ring of metal surrounding the cylinder, as indicated with the pencil, to prevent the using of a cold chisel to break off the front plate. The inside of the lock is cast with protuberances that engage with the cylinder and prevent its forcible turning.

The same principles are applied to the inside door bolt in the lower pictures.

EGGS ARE NOW dipped, for preservation, in an oil bath maintained at a temperature of 235 degrees F.

MAIL BAGS ARE dropped 5,000 feet from airplanes without damage, it is reported, by a new method devised for European airways. The device is secret, but is said to be a parachute operated by clockwork. Wayside stations are planned for receiving mail delivered in this new way.

### It Lifts Heavy Stone Blocks

**D**ESIGNED as a labor saving device for building industries by the U. S. Bureau of Standards, this stone-lifting contrivance does not need a double grip; it is plugged into a small hole in the surface of the stone, where it catches with a grip sufficient to hold the block firmly while it is being transferred from floor to truck or vice versa.



Lifting heavy block with the new hook

### Old Trolley Car Now a Lunch Wagon

**W**HAT becomes of old trolley cars? Are they rebuilt as the busses that in many places are displacing them, or simply scrapped as junk? New Jersey, at

least, finds a real use for them by converting them into lunch wagons. Several are now placed along the main shore highway leading to the New Jersey coast resorts.

Concrete blocks support the body at several points. A counter with stools in front of it and the usual cooking apparatus fit snugly into the space available, and a string of electric lights placed above the windows attracts attention. Comfortable and clean, the cars do a rushing business during summer.



Scrapped when the busses came, this old trolley car is now serving hungry Jerseyites as a convenient roadside lunch wagon

### Device Cleans Grain by Vacuum

**V**ACUUM-CLEANING grain to remove smut and light dockage is the job performed by the "Bates aspirator," the invention of E. N. Bates, market specialist of the Department of Agriculture. Grain thrown from the thresher elevator is spread in a flowing stream down the sides of a low flattened cone, while a suction from above draws a current of air upward through the thin layer of grain, cleaning out the lighter material.



# Inventors' IDEAS *That*

## *A Kitchen Table Becomes a Laundry Tub*



**Table Conceals White Enamel Tub**



The two pictures above show two views of the same piece of kitchen furniture—a combination table and laundry tub. Being white enameled, it can even be used as a bathtub! The change is accomplished simply by turning the table on the side. It is supplied complete with floor drain assembly



**Cores and Cuts at One Stroke**

Just a little pressure and the fruit corer above prepares an apple for serving at a moment's notice. The sharp cutting edges separate the core and also cut the pulp into dainty slices



**Scissors for Cutting Flowers**

It is possible to hold a flower below the point on the stem where it is to be cut, and snip the stem without the flower's falling to the floor, with the new scissors above. After the cutting edge does its work, the stem is grasped securely by the scissors



**Filtered Coffee Must Seep Through Pad, Too**

Filtered coffee should not only retain all desirable elements, but should lose all undesirable elements, say its advocates. The filter above carries out this idea. The coffee, after seeping through tiny holes, passes through a fiber pad which is said to hold back the harmful elements



**Sugar Pours through Spout**

A screw cap, threaded to fit various shaped containers, keeps the sugar in this bowl (left) always covered, protecting it from the assaults of wet spoons. The sugar pours out in a thin stream through a small spout. The device can also be used for certain varieties of uncooked cereal foods

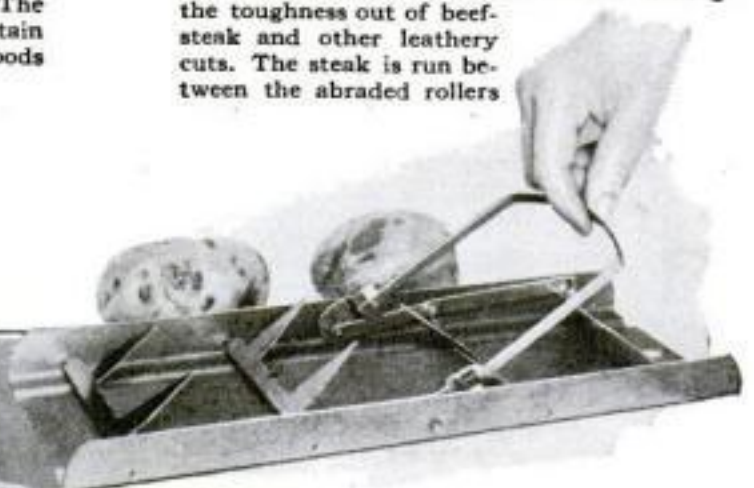
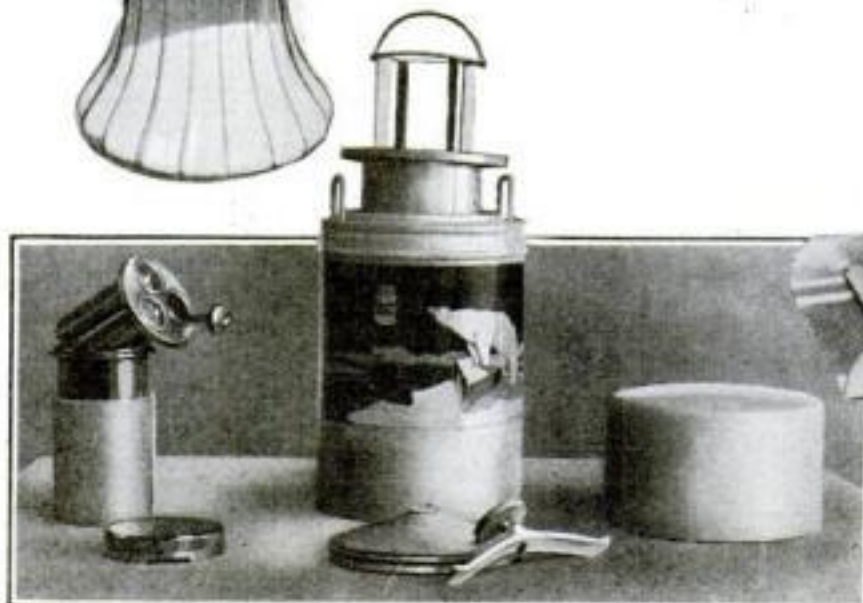


**Tender Steak from Tough Cuts**

A high school boy of Ada, Okla., invented the ingenious device above for taking the toughness out of beef-steak and other leathery cuts. The steak is run between the abraded rollers

**Why Not Make Your Own Ice?**

Six minutes is all it takes for this little machine at the right to make ice, according to its German inventor. A "cold mixture" made according to a given recipe surrounds a container holding water. The cover is screwed on, the apparatus is shaken slightly, and then let stand six minutes. At the left is a smaller size of the freezer



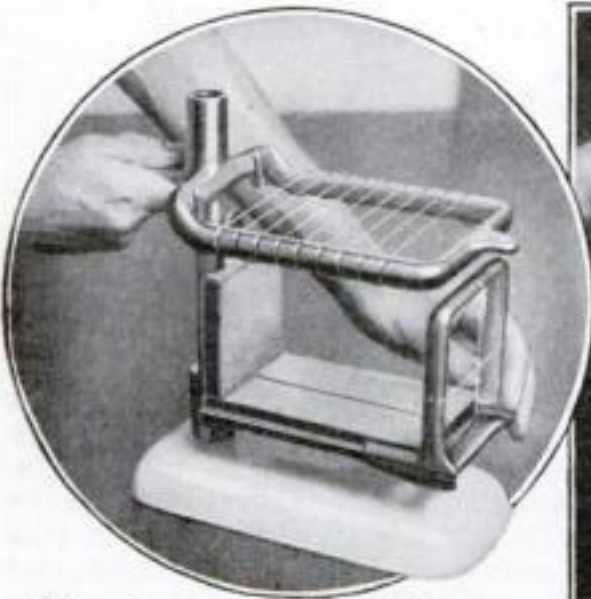
**Potato Baker Folds Up**

Potatoes baked to a toothsome consistency by the device above are said to be uniformly "done," dry and mealy. They are impaled on the eight prongs and hung over the fire or set in the oven. The handle regulates the prongs



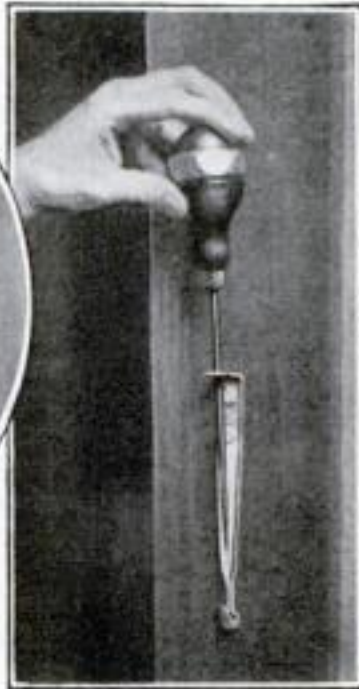
# Are *Easing* HOME Tasks

## and a Pocket-Size Machine Makes Ice



### Slices Butter into Small Squares

A pound bar of butter is sliced neatly into individual portions, with the tool above. The butter is placed on the lower plate and the device is slid back, the two crossed wires quartering it. Then the top part is pressed down, and the horizontal wires divide each quarter into ten equal parts

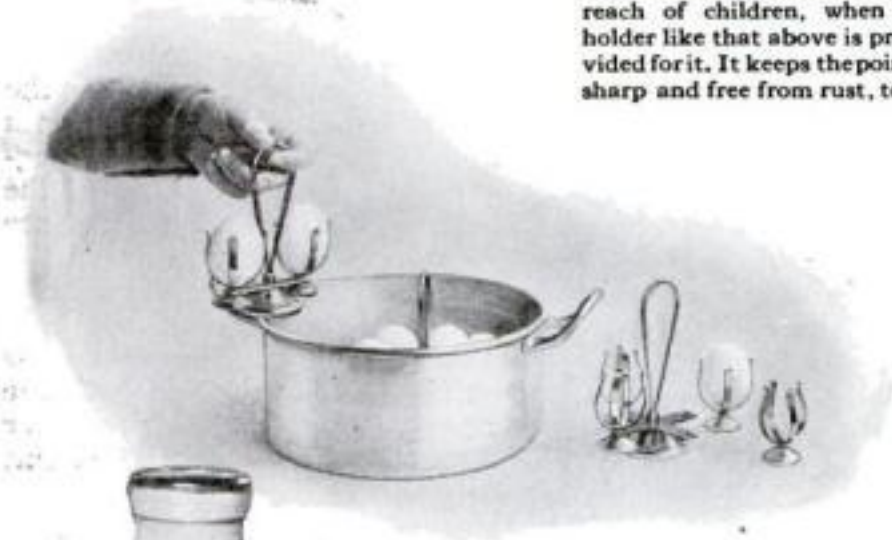


### A Holder for the Ice Pick

The ice pick can always be kept at hand yet out of the reach of children, when a holder like that above is provided for it. It keeps the point sharp and free from rust, too

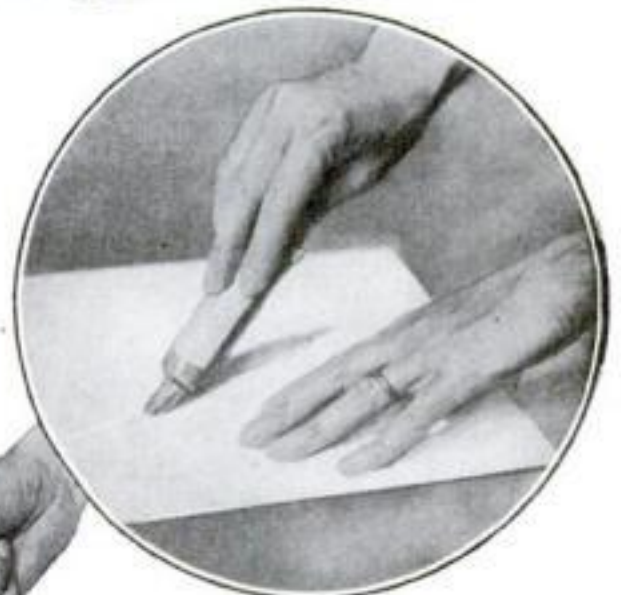
### Clothes Basket Stands on Legs

Folding legs on this wash basket save the laundress' back in lifting and bending, especially when she is hanging clothes on the line. The basket does not have to be set down to open the legs, a slight pull while holding it in the arms throwing them wide apart. Releasing catch refolds legs



### Boiled Egg Set Saves Fingers

Direct transportation of the hot boiled egg from the kettle to the table without burning the fingers is possible with this new outfit (left). The framework holding the boiling eggs lifts out of the kettle and dries at once, all ready for the table



### Glue Tube Seals Itself

There is a tip of soft rubber on the mucilage tube above, and the paste flows through a vertical slit to be applied on the article. After the job is done, the tube is sealed by the hardening of the mucilage in the opening



### Cream Whipper Fits in Fruit Jar

The double beating action of the device at the right makes it possible to churn butter, beat eggs, or whip cream quickly and easily. It is small enough to be inserted in an ordinary fruit jar



### It Opens Milk Bottles

The cardboard cap on a milk bottle is removed easily by means of a prong on the under side of this metal milk bottle cover (above)

### Cuts Potato into Ribbons

This ingenious cutting tool (right), clamped to the kitchen table, will cut potatoes and other vegetables into long spiral ribbons for fancy cooking. In the picture, the potato is lying flat against a disk knife which slices it as it revolves



### A Three-in-One Tool

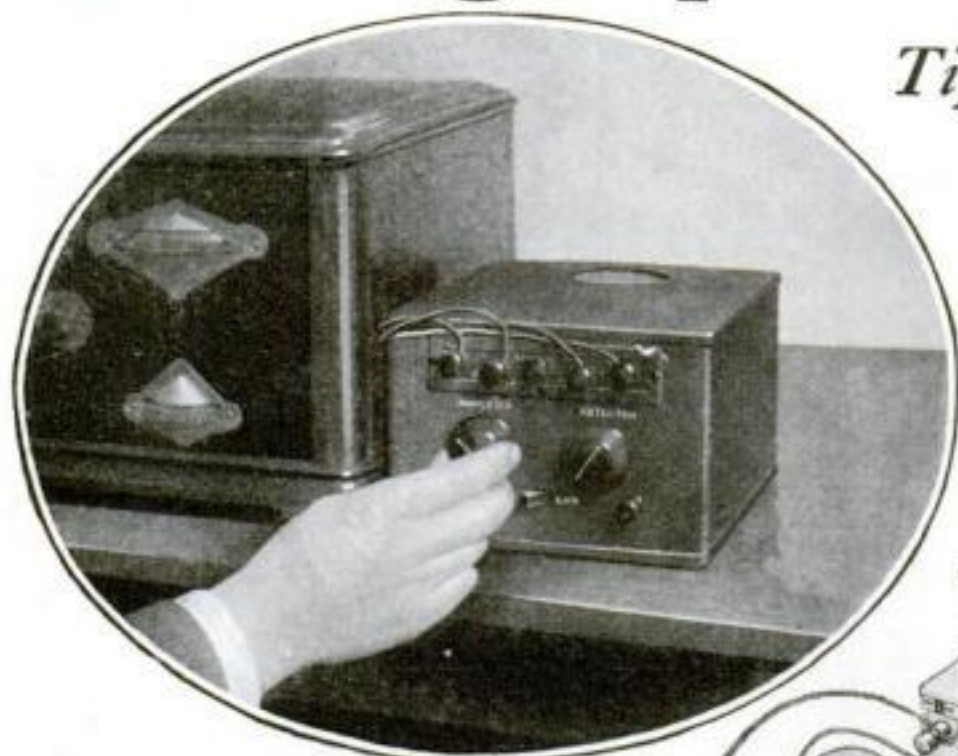
Three useful features are incorporated in the little tool above—a six-inch rule, a sharp edge for use as a letter opener, and, in one end, a small magnifying glass



# Tuning Up Your B-Eliminator

*Tips on Adjustments That Will Save  
Overloading Your Tubes and  
Insure Good Tone*

By  
HARRISON  
LEWIS



## Turn Adjustment Knobs Slowly

Correct setting of the variable resistances that control the voltages supplied to your set is important if you want to obtain good tone

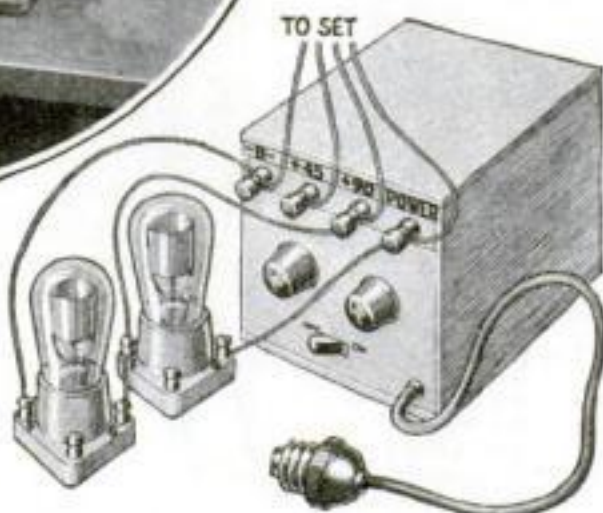
**I**N EARLY stages of the development of B-battery eliminators the designing engineers were confronted with two important problems. One was to find a reliable way to rectify the alternating current into pulsating direct current; the other was to smooth out the pulsations in the direct current so that it could be used in the B-circuit of a radio receiver. Every engineer concentrated on these problems, and in the modern type of B-battery eliminator both have been solved almost completely.

The direct current voltage delivered to the binding posts on the B-eliminator depends to a large extent on the rate at which current is drawn from the B-eliminator. The more current you draw the lower will be the voltage. In other words, if you have a receiver that draws very little current, the B-eliminator will deliver this current at higher voltage than it would if the set took more current.

**V**ACUUM tubes, however, work best at the voltages recommended by the manufacturers, and if they are overloaded the result will be a short life for the tubes. Your problem is to adjust your B-eliminator so that it will supply the required amount of current at exactly the right voltage. How to do this depends to a large extent on the receiver you have and the B-eliminator you buy.

The smaller types of B-battery eliminators that are sold at a relatively low price are usually provided with one adjustment so that you can get the detector voltage set at the proper value. The more expensive styles are fitted with two or more adjustment knobs designed to regulate the voltage delivered to each plus B binding post on the receiver. These adjustment knobs are connected to variable high resistances inside the eliminator case. Turning the knob to increase the resistance lowers the voltage, and cutting down the resistance increases the voltage.

At first glance it would seem that the simplest way to adjust the voltage would



## How to Connect Regulator Tubes

One can be used with almost any B-eliminator, but only the powerful instruments will work two in series to maintain 180 volts

be to use a voltmeter just as you do with batteries. But that method won't work because the current flowing through the voltmeter causes the reading to be much lower than it becomes the moment you disconnect the meter.

The most practical method will be to determine the proper setting by judging the results. The best way to set the detector B-voltage is to tune-in some station that comes in rather weakly or turn down the volume control on a local station until the music is weak. Then increase or decrease the detector voltage until the signal becomes as loud and clear as possible. It is always best to have the voltage set as low as you can consistent with good volume. There is less chance of hum with this setting, and owing to the nature of the detector circuit arrangement inside the B-eliminator, the lower you can keep this voltage the higher the voltages available on the amplifier circuits.

**T**HERE also is need for care in adjusting the amplifier voltages, because if you accidentally get them too high, the tubes will be overloaded and paralyzed within a short time. This is particularly true of the radio-frequency amplifier tubes if no C-battery is used on these tubes.

A popular method of controlling the volume of sound on the modern receiver is by means of a rheostat in the filament circuit of the radio-frequency amplifier tubes. Reducing the filament current through one or more of these tubes will cut down the volume without causing distortion.

Difficulty occasionally is experienced with a volume control of this type when

a B-battery eliminator is used. Assuming that you have set the adjustment knob on the B-eliminator for the proper voltage on the radio-frequency amplifier tubes when they are turned up to get full volume, there will be a sudden instead of a gradual falling off in volume when you turn the volume knob on the set. In other words, the volume control will be too critical. This peculiar effect is due to the fact that the tubes use less B-current with the lower setting of the volume knob, and consequently the voltage on the amplifier tubes rises. This higher voltage, in turn, still further reduces the volume with low filament temperatures.

One way to cure this trouble if it bothers you is to add a voltage regulator tube to the circuit. The connection is simple. Place an extra socket inside the receiver cabinet if there is room or mount it in a separate box near the eliminator. Connect the grid terminal of the socket to the plus B R F binding post (sometimes marked plus 90) and connect the diagonally opposite filament terminal of the socket to the minus B binding post. Place a UX-874 voltage regulator tube in the socket and then adjust the knob that controls this voltage until there is a steady glow in the tube when the volume is turned on full. This tube will hold the voltage at 90 regardless of how much or little current is drawn in the circuit within rather wide limits.

The drawing above on this page, shows how to connect up two voltage regulator tubes so that you can get a constant voltage of 180 for operating the new 171 type tube and 90 volts for the other amplifier circuit. This arrangement can be used only on the large and powerful types of B-eliminators, but you can use one regulator tube to advantage across the output of the smaller types of eliminators to hold the total voltage at 90 for use on sets that do not require more than this voltage.

These regulator tubes are particularly useful if you live in a small town where the voltage of the electric light current is not steady.

**T**HERE is one other point in the operation of B-eliminators that should be watched carefully. Never turn on the eliminator until after you have turned on the switch that controls the current to light the vacuum tubes, and always turn off the eliminator before you turn off the set. This procedure avoids placing excessive electrical strains on the large-capacity condensers in the eliminator. If you use voltage regulator tubes, no special precautions of this kind are needed, as the use of these tubes keeps the voltage constant whether the tubes in the receiver are turned on or off.



# If You Plan to Buy A Radio Set for Christmas—

**A**RE you thinking of presenting a radio outfit to your family as a Christmas gift? Or do you contemplate giving a set to a friend? In either case there are important things to consider before you make your purchase.

If your plans are not quite so ambitious and the Christmas money is to be invested in new equipment for your present radio installation, such as a modern loudspeaker, a new storage battery or a B-battery eliminator—here, also, are questions to be settled.

Before purchasing any type of complete radio set you must get clearly in mind just what you want in the way of radio entertainment. In other words, you must decide what features are most important to you, and after that you can begin your search for a receiver that will give you the kind of service you want at the price you can afford to pay. The same considerations, of course, will apply if you are buying a set for someone else.

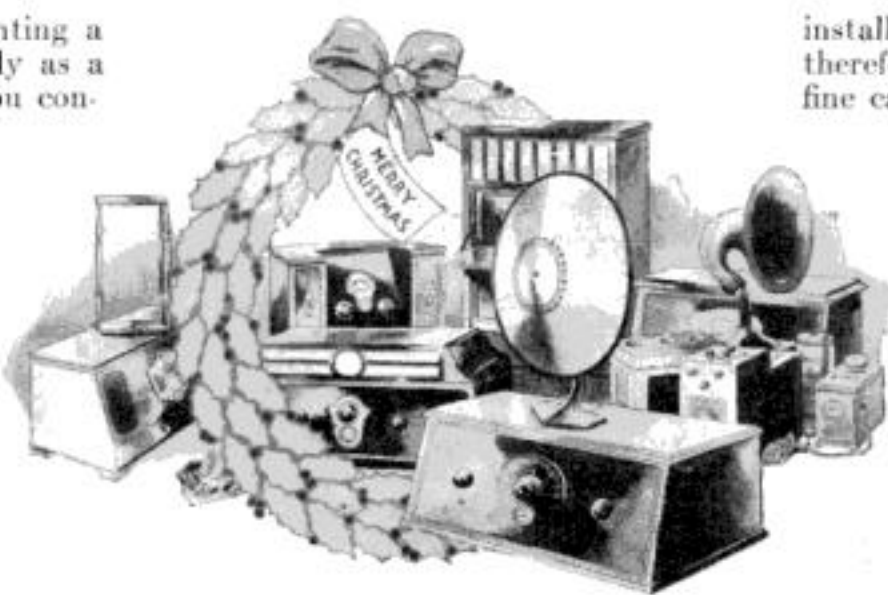
Your decision will be influenced to a large extent by your location. If you live in New York City, for instance, you will have less use for a receiver designed particularly to bring in distant stations. And this is also true if you live in any of the larger cities where there are a number of broadcasting stations. Whatever kind of set you buy, the local stations always can be received much better than those at distant points.

No matter where you are located, you will want accurate reproduction of music and speech. In fact, poor quality of reproduction is enough to condemn any radio set regardless of any other good points about the instrument.

In the early days of radio broadcasting, when all radio sets sounded like five-dollar phonographs, nobody worried about truthful reproduction. The mere wonder of hearing voices and music out of the air held everybody spellbound. It was enough if you could understand most of what the announcer had to say, and musical selections were distorted almost beyond recognition. A piano, for instance, generally sounded like a cross between a banjo and somebody pounding on a tin wash boiler. A modern radio receiver should reproduce a piano with sufficient realism to convey the illusion of the actual instrument to a person in the next room.

**T**HE number of tubes in a receiver has nothing to do with the tone quality. A five-tube set or even a three-tube set is just as likely to give correct tone quality as a receiver using seven or eight tubes, though the extra tubes may add to selectivity or distance range.

There is just one way for the novice to



*Don't stint on accessories,  
and insist on demonstration  
—Why the best is cheapest*

By ALFRED P. LANE

be sure of getting a radio receiver that has good tone quality, and that is to purchase a late model from one of the reliable manufacturers.

By all means avoid bargain sales. In almost every case the radio receiver offered in a bargain sale is a discontinued model or the product of some manufacturer who has gone into bankruptcy. In either case you are almost sure to get a set that is out of date or deficient in tone quality or some other vital feature. In fact no receiver of any make that was produced more than two years ago can equal in tone quality the better sets that are being made today.

Naturally you will take into account the appearance of your radio receiver. You will want it to blend with the other furnishings in the room in which it is to be

installed. It will be up to you to decide, therefore, how much you want to pay for fine cabinet work. Most manufacturers

are now turning out their receivers in various styles of cabinets. If you buy the more expensive models, in most cases you will be spending the extra money for looks, as the electrical units installed in the various grades of cabinets generally are of one single type.

**B**ARGAIN sales of radio sets usually stress the fact that the price includes a complete list of accessories. Often, however, the equipment sold with these bargain sets is of very low grade. "Bootleg" vacuum tubes, tin horn speaker and stale batteries may look all right to the novice radio fan, but they give such poor service that they actually prove more costly than good accessories.

It will pay you to buy the best accessories that the market affords. That means high grade, standard vacuum tubes, a modern cone-type loudspeaker, a well-known make of storage battery fresh from the factory, and the larger sizes of dry cell B-batteries or an up-to-date B-battery eliminator.

The cone-type loudspeakers are now being made by almost all of the leading manufacturers. Their growing popularity is a clear indication of the quality of present-day radio receivers, for a cone-type speaker will not give good results with a poor quality set. In fact when cone speakers were first introduced they came in for a lot of unjust abuse simply because they showed up the poor tone qualities of the receivers then in use.

If you want real quality, be sure to purchase a receiver designed to use the new type power amplifier tubes. The development of these new tubes is one of the outstanding advances in the radio art during the last year.

**H**EAR the set in actual operation before you pay your money, and insist on having the demonstration made with several different types of loudspeakers so that you can decide which type is most pleasing to your ear. In listening, pay particular attention to the low notes.

Eliminators to take the place of B-batteries have now been perfected to such a degree that they will give as good results as dry cell or storage B-batteries, and while they cost as much as four or five sets of B-batteries, the operating expense after the B-eliminator is installed is very low. With one of these instruments on the job, you will not have to worry about run-down or noisy B-batteries. In buying a B-eliminator, see it demonstrated in actual use on the particular type of radio set it is to operate.

## Watch These Points When You Buy a New Set

1. Choose a standard make.
2. Avoid bargain sales of obsolete sets.
3. Insist on a complete demonstration.
4. Make sure of good tone quality.
5. Buy high grade accessories.

Send for the list of radio receivers and accessories approved by the Popular Science Institute of Standards and use it as a guide in purchasing your new outfit.



## Hints for Radio Beginners

# A Sharp Drill Saves Labor

*How to Improve Cutting Edge—What Causes Weak Signals*



**Cutting Out the "Twang"**

Putting rubber pads under the corners of a radio receiver to prevent vibrations from traveling up the table legs and on to the vacuum tubes—a constant cause of trouble

**M**ANY radio fans complain about trouble in drilling holes in the composition panels sold for radio use. They say that drills dig in and jam and have a tendency to break through the other side of the panel, leaving a chipped and ugly-looking hole.

The cause of most of this trouble lies in the fact that ordinary twist drills are designed to cut through steel, and when they are used on a softer material such as bakelite or hard rubber, the angle of the cutting point makes difficulties.

To get best results in drilling these materials, you will find it desirable to stone the two cutting edges as shown in the photograph at the bottom of the page, so that the drill will have what is called a negative rake. In other words, the cutting edge of the drill will be shaped so that it will lose its tendency to dig into the material. A keen-edged drill stoned to a light negative rake will cut through bakelite or hard rubber with an ease that will surprise you.

In drilling holes in radio panels, it is best to drill the hole with a small-diameter drill and then follow with a drill of the size desired for the finished hole. Stoning the larger drill is particularly important in a case like this.

You will find that stoning the point of a drill also is advisable in drilling brass. It will eliminate the tendency to dig in.

### When Signals Become Weak

**B**EGINNERS in radio frequently are in doubt whether to blame their tubes or their batteries when the broadcasting becomes weak. Dry cell batteries of both the A and B type recover some of their strength when left unused for a day or two, whereas tubes that have become exhausted do not show this effect. Consequently, if you find that the radio set sounds almost normal for a few minutes just after you turn it on and then the music gradually grows weaker, you can be pretty sure that the batteries and not the tubes are to blame.

Weak dry cell batteries should be re-

placed by new ones, but exhausted tubes can often be given a new lease on life by the reactivation process. A reactivated tube may not last as long as would a new tube, but the rejuvenation process generally adds many hours to its life. And if it happens to burn out in the process, you can console yourself with the knowledge that the tube was probably too far gone to be brought back.

### Cushion It on Silence Pads

**D**OES your radio twang like a banjo string every time someone in the house slams a door or walks across the room? Most modern sets are built with cushion type sockets that eliminate this peculiarity. One way to get rid of it, if you have an older type of set, is to place rubber pads under each corner of the cabinet, as shown at the left. Two or three layers of rubber cut from an old inner tube will do the job. Shift your tubes around in the sockets, too, if the twanging is pronounced, because some tubes are more microphonic than others.

The tube in the detector socket is the one that is responsible for most of the microphonic noises.

### Handle Cone Speakers with Care

**T**HE cone type radio loudspeaker is, relatively speaking, a delicate piece of apparatus. You cannot bang it around and expect to get good results. In fact, one fall from the table to the floor is almost sure to ruin the paper cone and damage the electrical unit.

However, this does not mean that a cone type loudspeaker needs special handling or is likely to get out of order easily. On the contrary, it may stand up to the hardest kind of work for years.

If you want to get this kind of service out of your new cone speaker, put it where it is not likely to be injured—on top of a bookcase or near the back of a table that is placed against the wall.

While damp air will not affect its tone qualities, water splashed on it will damage the paper, so keep the speaker, also, where rain cannot reach it.

The amount of moisture in the air does cause the paper to expand and contract, but this expansion and contraction is taken care of, in some makes of cone, by the method of mounting, and in others a thumb nut is used to clamp the wire from the speaker

### A B C's of Radio

**N**O ONE—not even the foremost radio engineer—can predict the results that will be obtained with any particular type of radio receiver in any given locality. Of course if your neighbor next door gets good reception, the chances are that you can expect equally good results. But if you live in a section where there are no radio sets, you'll have to take a chance.

All that a conscientious dealer can say about the distance getting qualities of even the finest radio set is, "If the reception of distant stations is possible in your neighborhood, you can depend on this set to get results."

On the other hand, the question of quality of reproduction can be settled definitely. If a receiver gives a lifelike imitation of the real thing in one locality, it will do the same in any other place.

Before you buy a radio set, be sure to learn what kind of reception is possible in your neighborhood.

If you live in an apartment, make sure you can put up an antenna if one is needed for the set you expect to buy.

unit to the apex of the cone. Releasing this thumb nut and tightening it again relieves the strain caused by expansion and contraction.

It is desirable that the clamp nut be loosened and tightened again whenever there is a change in weather conditions. In other words, if the weather becomes damp after a long dry spell, or dry weather follows considerable rain and fog, the expansion or contraction of the paper should be compensated for by this adjustment.



Changing the angle of the cutting edge of a drill to make it work more quickly and cleanly on such materials as bakelite, hard rubber, brass and so on

### Tune Back and Forth

**W**HEN you are trying to tune-in as accurately as possible to a certain station, you will find a little stunt used by professional photographers a great help. They always focus a camera by turning the focusing knob back and forth beyond the correct point, less and less each time, until the motion finally stops at exactly the right point.

Applied to radio, this means that you must move the dial or control back and forth until your ear tells just where to stop.

A vernier dial will prove a help in fine tuning.

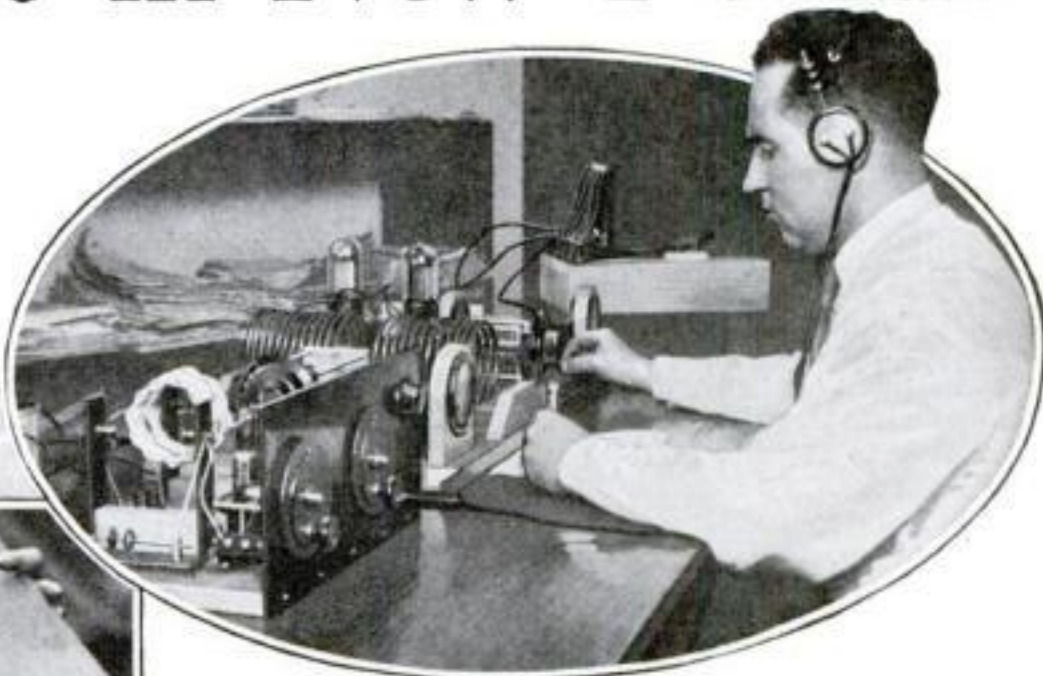


# Radio in New Forms



## Loudspeaker Shaped Like Book

In appearance this new type loudspeaker above (bottom view at right) looks just like a large book opened and supported at the correct angle for reading. The electrical unit is concealed underneath the curving diaphragm of heavy paper "pages"



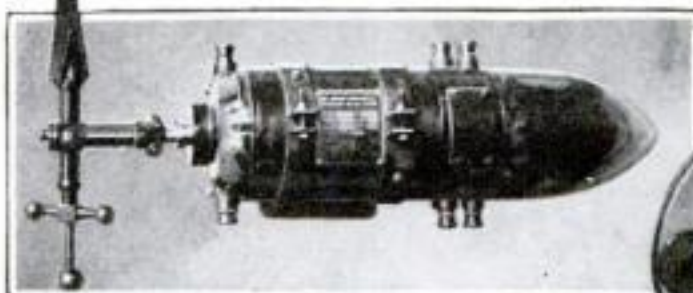
## Emergency Trains Dispatched by Radio

The Chicago, Milwaukee and St. Paul Railway is completing the installation of a short wave radio system that will serve for the reliable dispatching of trains during emergencies such as tornadoes, landslides, washouts and other disasters that interrupt train-dispatching service over telephone and telegraph wires. Walter Dietze, of the company, is shown above testing it



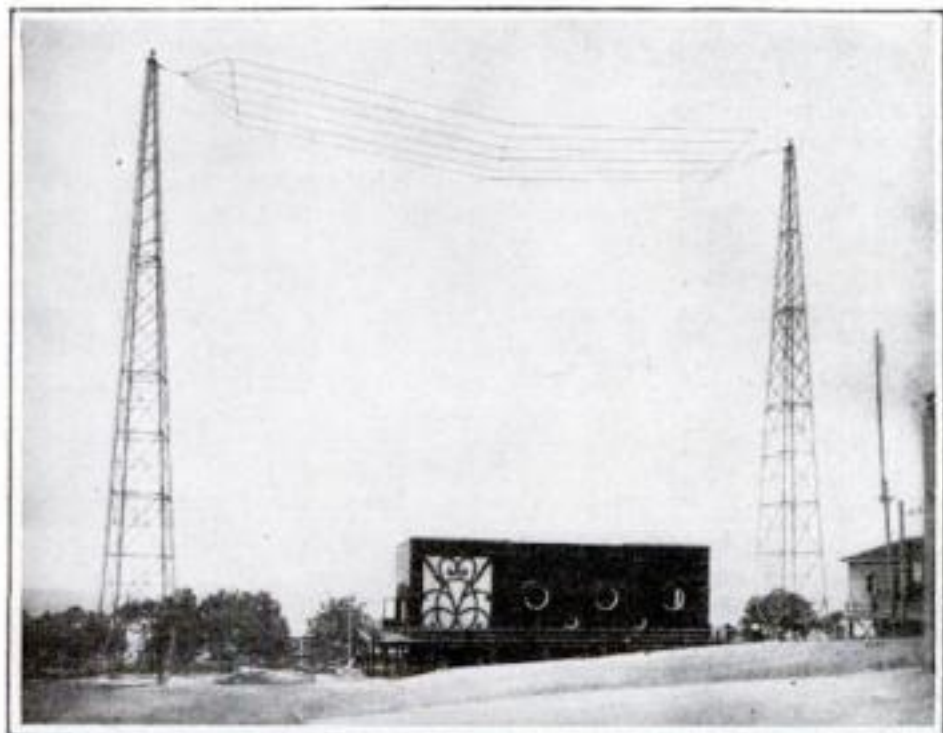
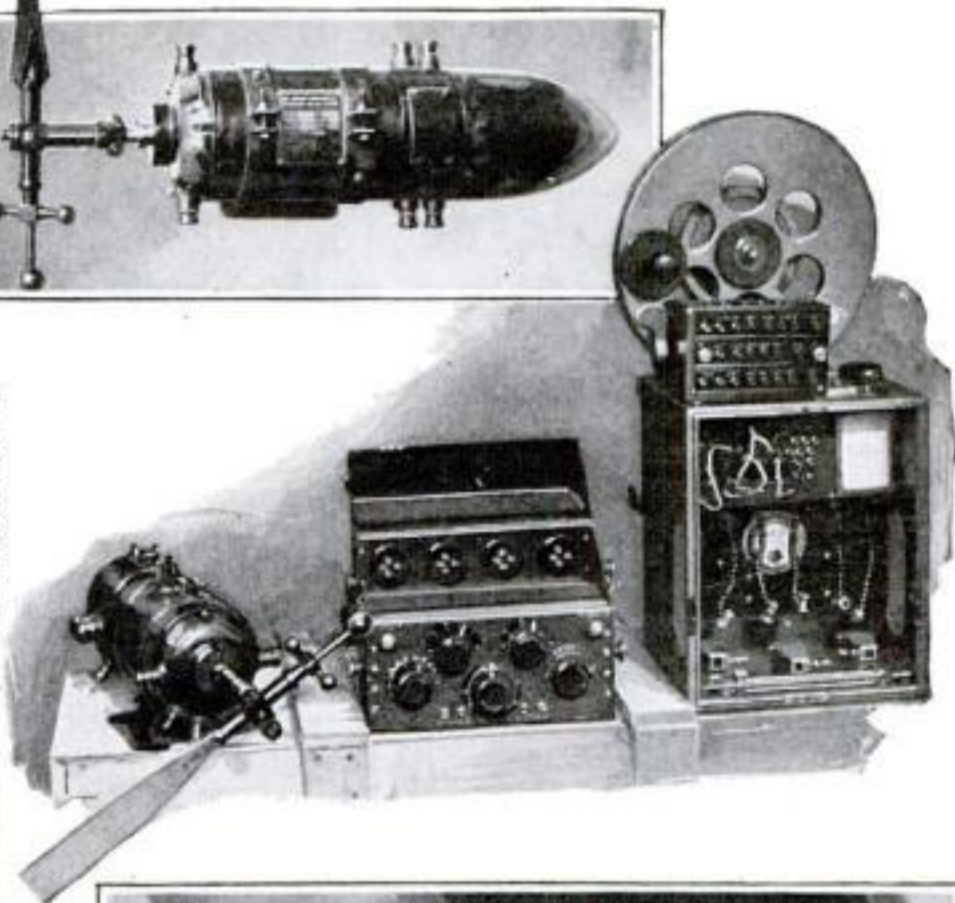
## Illuminated Control

Left: The celluloid dial and all the mechanism are mounted back of the panel with a special bezel frame let into the panel in the position illustrated. The top button turns on a small electric bulb behind the dial



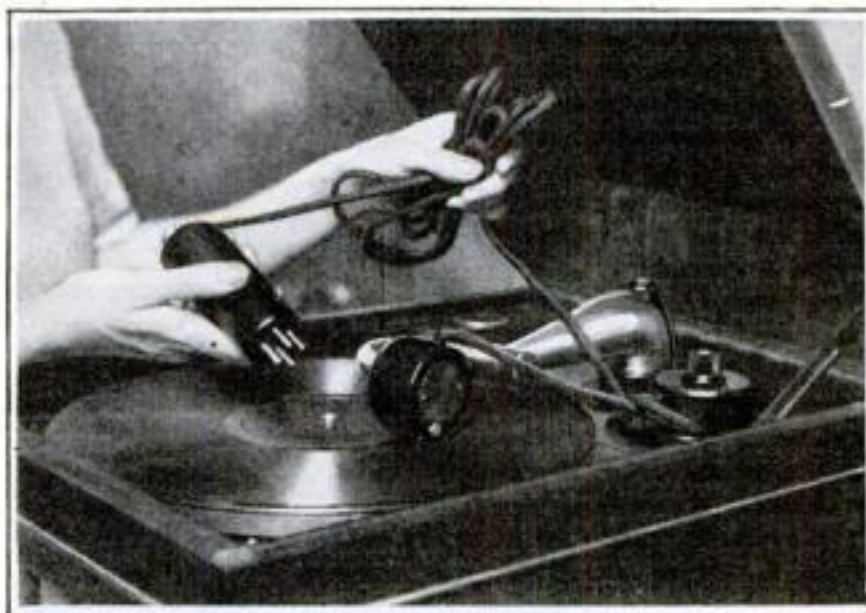
## Propeller Controls Voltage

A unique feature of the latest French airplane radio set is the voltage control of the generator. No matter what the speed of the plane through the air, the springs controlling the propeller, as shown in photos at right, adjust it to turn the generator at constant speed



## Broadcast Studio Looks Like Radio Receiver

Station WPAP at Palisades, N. J., has built a studio, above, modeled after a radio receiver. Round windows represent the dials. The loudspeaker opening can be seen at one end of the building



## Attachment Connects Phonograph to Radio Set

The plug shown in the illustration above is substituted for the detector tube in the radio set, and volume is controlled by turning the control unit knob. No extra batteries are needed



# What's Wrong *with* Spratt's Car?

*See If You Can Figure Out What Happened—Here's a Chance to Test Your Auto Knowledge and Win a Prize*

**H**ENRY SPRATT jiggled the spark lever up and down in a vain effort to make the top of the hill on high.

"We shouldn't have to shift into second on a grade like that," he grumbled, as he pulled over to the side of the road and stopped the car.

"I told you you were crazy to buy a secondhand car and start right out on a long tour with it," replied Mrs. Spratt. "You might know something would happen."

Henry untangled his long frame from beneath the steering wheel. "Don't start crabbing so soon," he said. "I know what's the matter now. The spark is no good because the contact breaker points need cleaning. Just watch me and you'll see how the job ought to be done."

"I hope you're right, Henry," sighed Mrs. Spratt. "Is that what's been making the engine miss so much? I thought when the engine missed it was always the spark plugs needed cleaning. You told me that yourself."

"It depends on how it misses," Henry asserted loftily. "If the miss is regular and keeps time with the revolutions of the engine, it's always a spark plug; but if it skips at random you can't blame any one spark plug. There's only one pair of points that make contact for all the cylinders, and if they get rough the motor is likely to miss in any cylinder."

"**S**EE, here's the trouble. I was right. The current has burned a hole in the stationary contact and all the metal out of the hole has piled up in a cone-shaped point on the other contact."

"What are you going to do about it?" questioned Mrs. Spratt. "You certainly can't cut off that point and put it back in the hole where it belongs."

"Certainly not," Henry admitted. "But I can use this file to get rid of the hump on one contact, and I can file off enough of the other to get it smooth and flat again. The secret of this job is to get each contact rounded just a trifle so that when the two come together they'll touch in the middle instead of at the edge."

Henry proved he was right, for now the motor ran without a skip. They hummed along at good speed for several miles. Then—

"My goodness!" exclaimed Mrs. Spratt. "My feet are burning up. Are you sure the motor isn't on fire, Henry?"

"It is kind of warm," agreed Henry. "I'll stop and see what's the matter." As soon as the car came to a standstill a gentle hissing noise became audible and wisps of steam floated up from underneath the radiator. Henry shut the motor off.

"The fan belt seems to be all right and the radiator isn't leaking anywhere," he

Henry soon had the hood up. As soon as he turned the knob to cut down the gas supply the idling motor picked up speed and ran quite steadily. "There you are! All set again," he said as he settled his long frame behind the steering wheel.

The car ran fairly well for several miles and then on a steep hill the motor refused to pull except in first speed. In fact they barely made the top of the hill even in first.



## Can You Help Him Find the Trouble?

"**I'M STUMPED**," said Henry Spratt despairingly, as he gazed at the motor of his stalled car under the feeble rays of the trouble light.

Can you help him out? Read the accompanying story through to the end, then write to us telling just what you would do in similar circumstances. There's a prize of \$25 for the best letter.

observed, puzzled. "I know there's plenty of water in the radiator—Ah! Here's the trouble! Look at that upper hose connection. See how the rubber is all swelled out? It's getting rotten and I'll bet the inside layers of rubber have swelled, too, and closed up the passage. I'll drain the radiator far enough to get the water level below where that bum hose is. Then I can take off the hose connection and cut out the extra rubber."

Again Henry proved he was right. He made the repair quickly.

"I hope nothing else happens," said Mrs. Spratt a bit more hopefully.

"Knock on wood and trust in me," Henry suggested. "I'll keep the old bus running unless the wheels fall off or—Confound it! She's missing again! Now what's the trouble? Acts like the mixture is too thick."

"Oh, dear!" wailed Mrs. Spratt. "You will never get it fixed now. It's as dark as pitch."

"Humph!" growled Henry. "Don't you think I can set the carburetor in the dark? Just watch me!"

**T**HE missing, and weak, uneven running became more pronounced until finally the motor quit firing completely and the car rolled to a standstill.

"I didn't stop it," snapped Henry peevishly, in answer to the unspoken question in his wife's eyes. "It just naturally died. Something must be wrong with the carburetor. The gasoline is dripping out of it to beat the band. That means the float is on the blink or dirt has jammed the float valve."

"There!" he exclaimed, after he had taken off the float bowl. "What did I tell you? Look at all the dirt in the bottom of the bowl. After it's cleaned out it ought to run as fine as silk."

Henry was doomed to disappointment, however, for although the motor started, it promptly stopped again to the accompani-

ment of a gurgling, strangling noise. A second later gasoline started to flow out of the lower air intake of the carburetor in a stream.

He groaned, grabbed a wrench and attacked the carburetor again. The second cleaning did no more good than the first.

"I'm stumped," said Henry despairingly as he rested his elbows on the front fender and gazed at the motor under the feeble rays of the trouble light. . . .

## What Would You Do?

POPULAR SCIENCE MONTHLY will pay \$25.00 for the best letter explaining the nature of the trouble with Henry Spratt's car and telling him how to overcome his difficulties. Your letter will be judged solely on how accurately you size up the trouble and suggest the remedy. Mistakes in grammar or punctuation do not count. Address your letter: Automobile Editor, Popular Science Monthly, 250 Fourth Avenue, New York City. All letters must be received before January 15th, 1927.



# for Christmas OH BOY!



**IT'S** an even break in thrills when Father buys the Boy a Conn for Christmas!

Dad gets his fun in seeing the Boy so happy. And as for Son, well, "Oh Boy!" is as near as he can put his feelings into words.

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The increasing number of school and college bands and orchestras enlarges students' opportunities and shows how educators value this training. Many of America's leaders in business, statecraft, and the professions have earned their education by cultivating their musical "bump." *Learning by new advanced methods makes playing a Conn fun from the start.*

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# Seven Useful Ideas for Your Car

## Extra Wheels Save Chains When Driving on Snowy Roads

**W**HILE many motorists seem willing to take a chance on driving without chains on wet roads, such protection is absolutely indispensable in the winter when the roads are covered with deep snow.

Snow, however, often covers the road only in spots, and the chains wear rapidly when you strike the bare road surface.

A most ingenious way to get around this difficulty is to fit an extra wheel to each of your regular rear wheels, as shown in Fig. 4. Four wooden blocks are bolted to the spokes, and the extra wheel is mounted on these blocks. The diameter of the extra wheel should be enough smaller than the wheel to which it is bolted so that the chain will not touch the ground when you strike surface that is not covered with snow.

This arrangement has still another advantage in that the wide tread presented by the double wheel effect keeps the car from sinking into the snow.

### Wooden Wedge Supports Spring

**W**HEN it becomes necessary to replace the ordinary type of rear spring shackle bolts or bushings, you will find a wooden wedge extremely useful (Fig. 3). It should be made of hard wood, as wide as possible without sticking against the sides, and the wedge should be gradual.

When you want to remove the bolts, drive the wedge in place just tight enough to take the weight off the bolts. It is unnecessary to jack up the frame of the car.

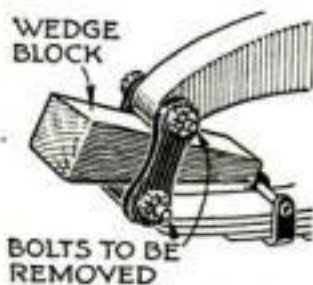


Fig. 3. Use a hard-wood wedge like the one shown above when you change spring shackle bolts. It will save jacking up frame.

### Rubber Band Stops Chafing

**F**LAT tires are often caused by the chafing of the tube against rough or rusty spots on the rim between the beads of the shoe. A regular fabric flap is sold to eliminate this trouble. If you have no flap, a good substitute is to cut a strip from an old inner tube and place it as shown below in Fig. 6. If you cut a piece out of the band and cement the ends together, the spring of the rubber will hold the band in place. Sewing the ends of the band holds the joint tight.



Fig. 6. A rubber band cut from an old inner tube prevents chafing.

### It Holds the Flashlight

**R**epairing or changing auto tires at night is a nuisance unless you can arrange to have sufficient light to see what you are doing. A standard



Fig. 1. A good flashlight at the correct height on a wire stand of this type will take much of the discomfort out of tire changes at night.

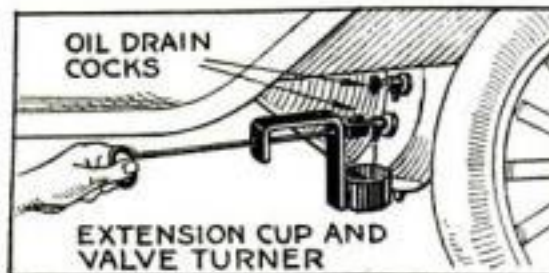


Fig. 2. Equip your valve turner with a cup of this type and avoid spilling oil on floor. Be sure that it turns freely.



Fig. 4. An extra wheel bolted on in this way will prove useful in heavy snow and save unnecessary wear on the tire chains.

type of flashlight will give enough light, but if you are alone in the car it is inconvenient to have to hold the light and work at the same time.

One way out of the difficulty is to bend up a simple wire stand as shown above in

Fig. 1, to hold the flashlight. Any piece of heavy wire will do. A loop bent as shown serves as a sufficiently firm base, and the upper end of the wire can be formed into a cradle for the flashlight.

### Cup Catches Oil Dripping from Petcock

**O**N CARS fitted with small petcocks to determine the level of the oil in the crank case, oil is bound to be spilled on the floor of the garage when the oil level test is made. A way to eliminate this trouble is suggested in Fig. 2.

Long-handled keys for these petcocks can be obtained in almost any auto supply store, and a small metal cup is riveted to a piece of thin strap iron that is bent as indicated.

The hole through the bent iron should be large enough to allow the cup to turn easily and consequently remain underneath the petcock as the latter is turned.

### Jeweler's Saw Saves Time

**I**T MAY frequently happen that a turnbuckle used to adjust the length of a brake rod on your automobile is turned so far that the ends of the rods are brought against each other, preventing any further tightening.



Fig. 5. A jeweler's saw will save time when a turnbuckle has reached the end of the adjustment. These blades will easily cut through all sorts of brake rods.

It is possible, of course, to turn the turnbuckle backward until the rod ends are released, and then saw off a piece of each rod with an ordinary hacksaw. But a much simpler way is to use a jeweler's saw, as demonstrated in Fig. 5, and cut off the rods without disturbing the adjustment. The blade

is tightened after it is passed through the opening in the turnbuckle.

### A Running-Board Ice Carrier

**T**HE most convenient place to carry a large chunk of ice in an automobile is, of course, on the running board, but if you have ever tried it you know it is rather a difficult job to strap the ice in place satisfactorily.

A few special studs mounted on the running board will solve the problem. As shown in Fig. 7, they are made of  $\frac{1}{2}$ -inch carriage bolts with a hole drilled in the bolt to accommodate a  $\frac{1}{4}$ -inch pin. When not in use the pins can be lifted out of the holes in the bolts and then stowed away in the automobile.

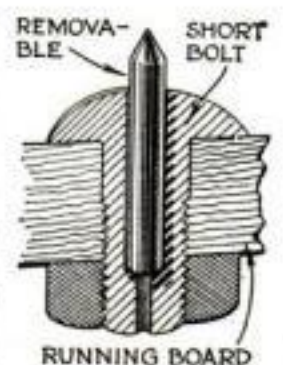


Fig. 7. Studs like these will make it easy to carry ice on the running board.

### Ten Dollars for an Idea!

**ROSS H. ARNETT**, of Medina, N. Y., wins the \$10 prize this month for his suggestion of extra wheels to save chains in winter driving (Fig. 4). Each month **POPULAR SCIENCE MONTHLY** awards \$10 in addition to regular space rates to the reader sending in the best idea for motorists. Other published contributions will be paid for at usual rates.



# The New Ferguson

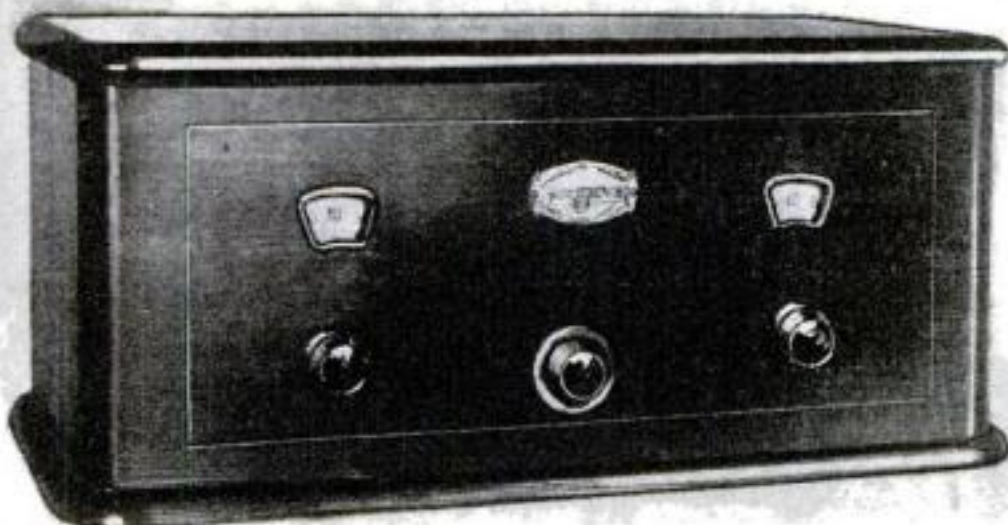
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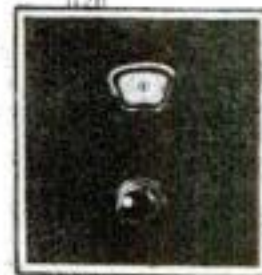
**W**ITH the FERGUSON Model Twelve you enjoy absolute fidelity of tone. The rendition in the distant studio reaches your living room round, full, clear—with all of the original expression of the artists. When an orchestra plays, you hear all of the notes both treble and bass—the harmony of the whole. The music rests and soothes you—as it should—because the true tone colors; all of the countless delicate shadings and overtones; reach you unaltered—in perfect timbre!

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Tool Chest



## A Christmas tip from the carpenter

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Right there is a Christmas tip from the carpenter—a chest of Stanley Tools this year for some man or boy! A fine assortment of tools, and all good tools—the right set for repair work or the making of such things as book cases, dog houses, and other useful articles. The sturdy oak chest keeps the tools safe and handy. A Stanley Tool Chest is a complete gift.

You will find Stanley Tool sets at a wide range of prices and in a wide

variety of assortments—from No. 904 with 12 tools in a fine oak chest at \$15, to No. 850 with 49 tools in a beautiful cabinet at \$95.

There are also assortments of the same Stanley Tools in cardboard display boxes *with simple directions from which the recipient can make his own chest*. There are several of these "Make Your Own Chest" assortments, at prices from \$5 to \$20.

There's a *Stanley Tool Set* to fit every pocket-book!

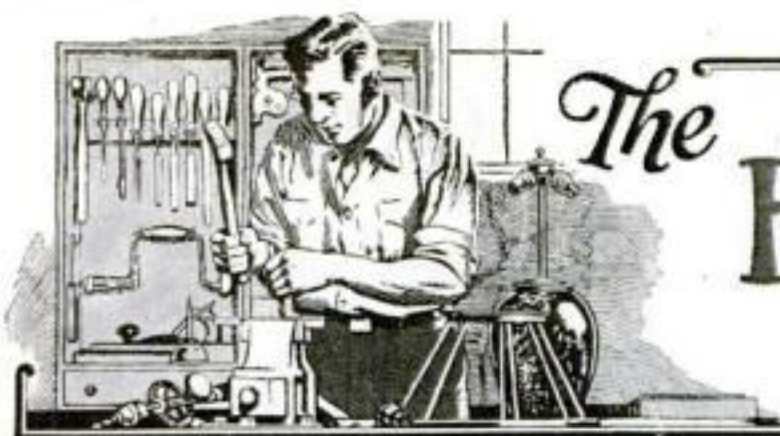
Ask your hardware dealer to show you the line of Stanley Tools. And send for our Catalogue No. 34-E which describes Stanley Tools both separately and in assortments. Address: The Stanley Works, New Britain, Conn.

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IS

# STANLEY TOOLS





# The Home Workshop

Arthur Wakeling, Editor

## How to Make Fascinating Toy Birds and Animals for Christmas

By F. CLARKE HUGHES

**T**OY making is not difficult. It may be done quite as well by women and girls as by men and boys. In fact, very few of those who have never attempted the work realize how simple it is to construct attractive toys—toys that will give keen and lasting delight to the children who receive them on Christmas Day.

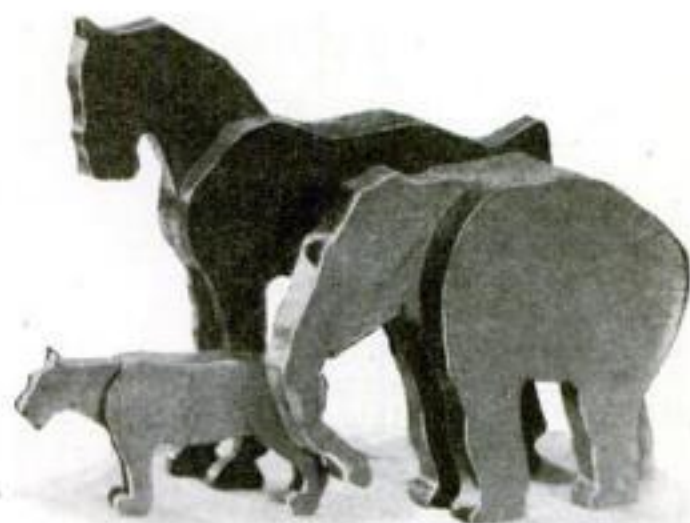
About the only equipment necessary for making many little toys such as are to be seen in gaily decorated shop windows at this season of the year are a coping (fret or bracket) saw, a jackknife, a hammer and a rule.

While other tools are sometimes needed and are always useful, they are not essential. Do not, therefore, let the lack

of tools or a bench prevent you from beginning.

Once you have fallen under the fascination of the work and discovered what fun there is in making toys, you will delight in adding new tools to your kit, and in a short time you will have a home workshop equipped for much more ambitious undertakings. That's the joy of working with tools; you always have something to look forward to—something new to make, some new process to learn, some new materials to experiment with, some new tools to buy.

The subject of tools cannot be dismissed without mentioning a lathe. Indeed, for many of the spindle toys so much in vogue these days, a wood turning lathe is the thing to use. Those who be-



Well-designed wooden animal toys are more popular today than ever and making them is great fun

come thoroughly interested in toy making will want to have a lathe sooner or later, but in the beginning it is usually possible to devise a substitute tool process or change the design of the toy so that turning is not required.

In cutting out practically all of the toys illustrated in this article, an ordinary coping saw is sufficient. These saws may be purchased at hardware stores and are among the most inexpensive of tools. A supply of extra coping saw blades should be obtained; they, too, are cheap, so that the breaking of them, which is bound to happen now and then, is a small matter.

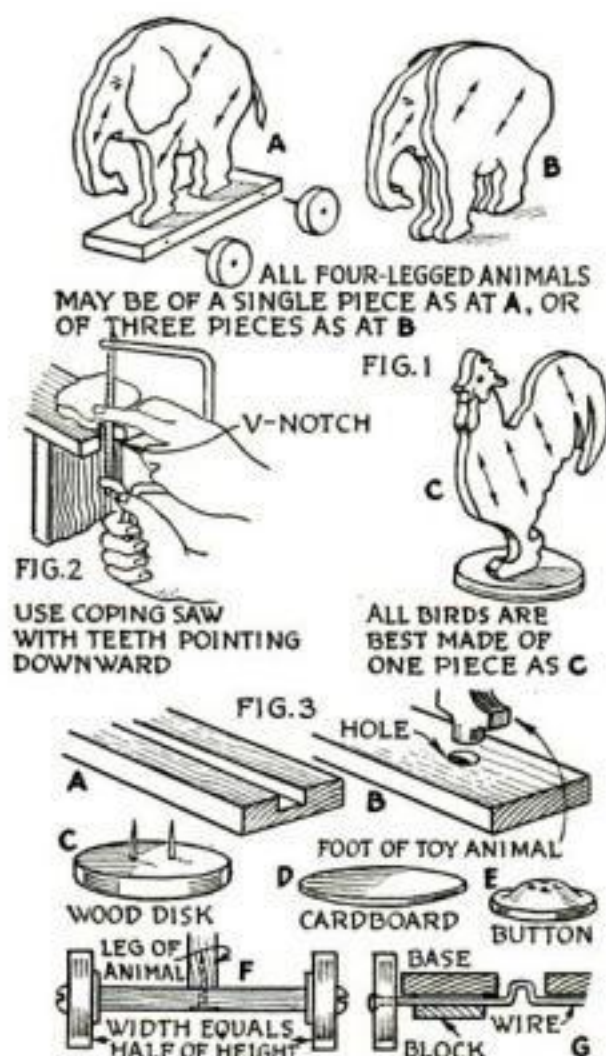
The correct method of using a coping saw is illustrated in Fig. 2. Boards as heavy as 1 in. in thickness, if of white pine, basswood or any soft wood, may be sawed quite easily in this way.

In Fig. 9 (page 101) are shown a number of animal forms that were drawn especially for wooden toys. These may be enlarged and used as patterns for toys of many types and sizes.

**D**ECIDE first to what size you wish to enlarge the toy. Draw on a piece of stiff paper or thin cardboard the same number of squares as appear over the outline you intend to copy, but make the squares proportionately larger. In each square draw whatever appears on the corresponding but much smaller square in Fig. 9, so that you will obtain an exact enlargement of the original drawing.

"What a lot of drawing to do!" you may say. Well, then, don't do it. Send for Home Workshop Blueprint No. 56, using the coupon on page 102. It contains every one of the designs in Fig. 9 drawn full size, ready for tracing directly on the wood. The elephant, for instance, is 7½ in. long over all and 5½ in. high; the pelican is 7 in. long and 5½ in. high; the puppy dog is 4½ by 5 in., and the others are of

(Continued on page 98)



One- and three-piece toys and several types of bases; how to cut forms with a coping saw

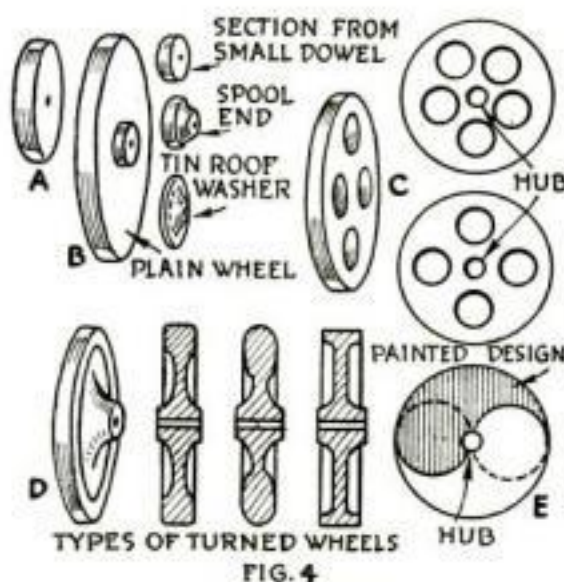
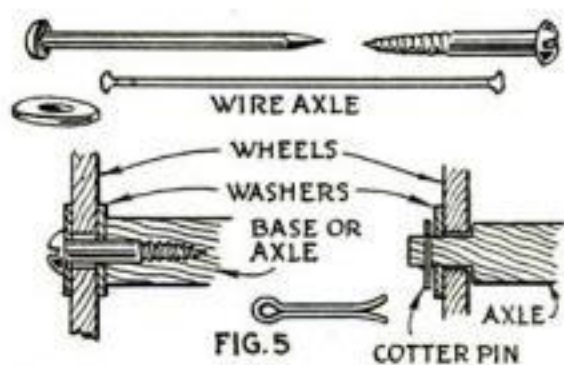


FIG. 4



Wheel construction at a glance—various hubs, decorations, and methods of mounting



# Brush Lacquer *and* Your Car

*How a Brilliant, Durable Finish  
Can Be Given Any Automobile*

By RALPH G. WARING

"ALL ready to start lacquering the car, Dan?"

"You bet, Mr. Waring!"

"Then get an inch and a half fitch brush, and a three-inch brush, as well. I'll meet you in the garage."

First I asked Dan to sprinkle the floor with the watering can. Although lacquers do not absorb dust as readily as varnish and enamel, this precaution is worth while. Next we washed the brushes clean with lacquer thinner.

The lacquer was stirred thoroughly for about five minutes to insure a perfect blend of pigment and lacquer body.

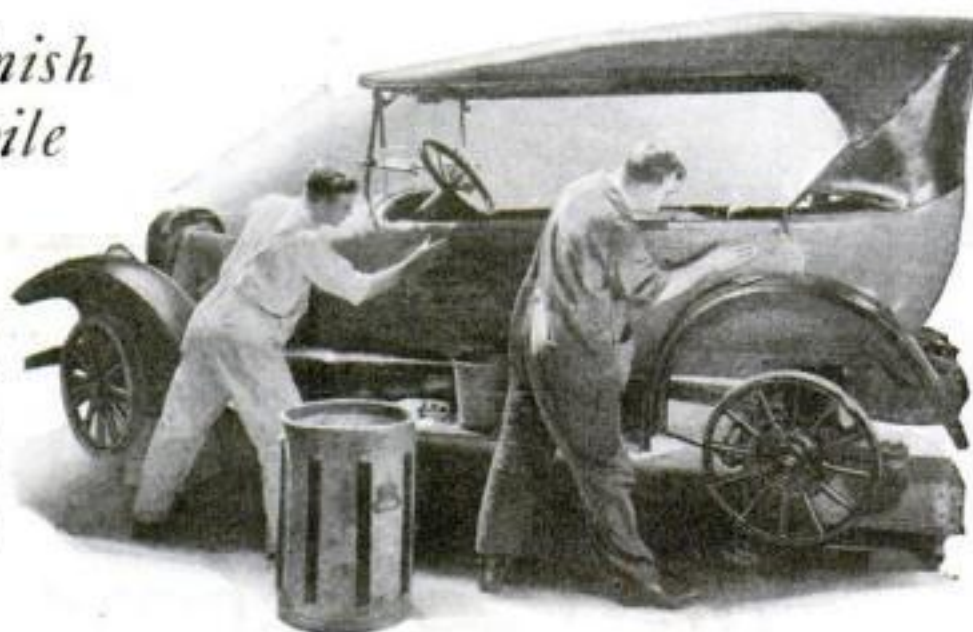
Using the smaller of the brushes, I showed Dan how to cut across the top of the door, working from left and right towards the center of the roll edge with a fully loaded brush. This left a plump surface; it was brushed just enough to prevent having the lacquer sag.

A newspaper was pushed quickly into place between the skirt of the body and the chassis frame to catch drips from the 3-in. brush, which was used to flow the brushing lacquer across the panel, working as on the roll. The lower edge of the last brush stroke was always wet and heavy enough to flow into the top of the next stroke.

Dan and I found that it required considerable judgment to determine just when to stop brushing, and just how much material the brush should carry without having a sag. Luck was with us. Except for one small sag in the lower corner of the door, the surface looked fine.

"We won't worry about that," I consoled Dan, "for when it has dried, we can cut it out with water sandpaper. We'll make haste slowly, however, and

The lacquer was rubbed to a glass-like surface first with very fine sandpaper and a mild soap solution, then with a mixture of pumice, whiting and suds



gain a little experience in our brush work as we go along.

"Let's do the cowl next. I shall start here on the lower right side, brush in this panel complete, cross over the cowl with strokes parallel to the windshield and work only from the unfinished part to the fresh lacquered work, all with a rather short stroke."

WHEN it came to the rear of the body, I started on the right side, next to the rear doorframe, and brushed in lines parallel to the fender, keeping the fresh work always at my right until I had advanced past the shoulder, then I found it was easiest to take a stroke of from 4 to 6 in. long, moving quickly from left to right, and a similar stroke one brush width lower down. The strokes faded out quickly where they met on the freshly lacquered shoulder. In this way I was able to flow out the lacquer just as I had on the door and a smooth job was the result. It seemed that the lacquer set too quickly to take a chance on using an up and down stroke.

"Now, Dan, let's set the hood over on this low sawhorse," was my next suggestion. "That's right, turn it so that the ventilating slits on the side have the edges pointing down. The face of the hood we will flow-coat with the three-inch brush as far as the hinge roll. The ventilated faces

can best be worked with the inch and a half brush. Notice I start the stroke from the end of the slit toward the center, working from both left and right, thereby avoiding the possibility of a sag at the corner."

This done, Dan went ahead with the black work on the fenders and I did the many little odd jobs of touching up around the windshield and radiator, frame, lamps and elsewhere.

We gave the lacquer a five-hour drying period before applying the second coat. We found that this coat took hold of the first just enough to make the brushing a little harder, but not enough to be really troublesome. Unlike varnish and enamel, lacquer does not require to be sanded between coats. That is because lacquer coats dissolve one another partially and so bond perfectly.

"We'll let this last coat dry overnight," I told Dan—it was late anyway—"and then we'll come here the first thing in the morning to water-sand and polish the car. You remember that in the experimental work the lacquer sanded better with a neutral soap solution in place of clear water, so I want you to cut up a small size bar of white soap and put the chips in a gallon jug full of cold water. In the morning it will be ready."

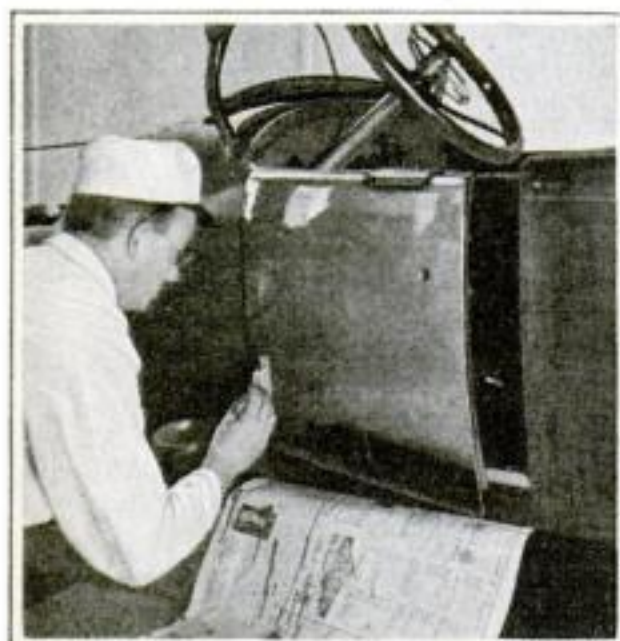
DAN was waiting for me at the garage the next morning with his usual smile. He was inspecting critically the work we had done.

"It's pretty good in that eggshell finish, just as it is," he remarked.

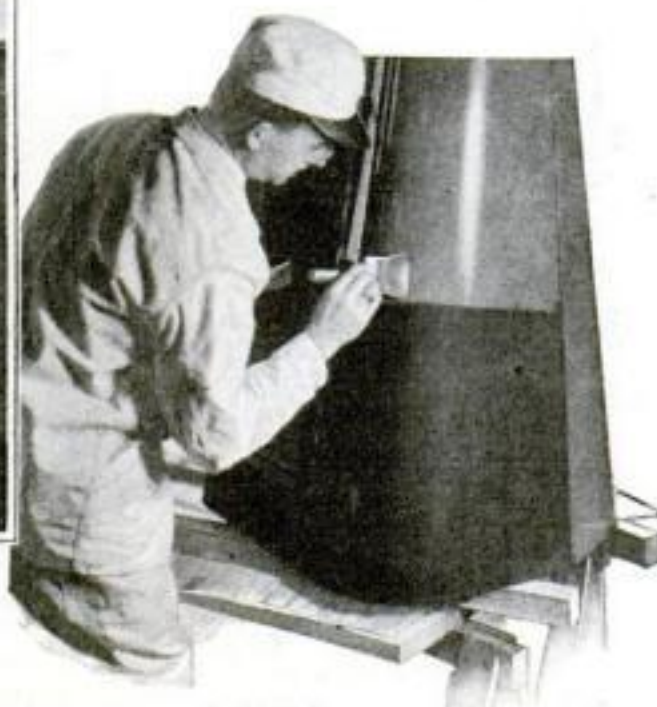
"Nevertheless, it will be a lot handsomer if we sweat over it for a few hours," I assured him. "Pour out some of that soap solution into one of the shallow pans, and mix one third whiting with two thirds FF pumice stone to a soapy paste. Tear up a bunch of six-0 sandpaper of the wet-or-dry type into eighth sheets and then we will go to it. Have a pail of the soap solution handy to dip the paper in and another pail of clean water, with a chamois and a sponge."

I demonstrated just how to hold the piece of sandpaper with one corner caught between the thumb and first finger, and the diagonally opposite corner between the little finger

(Continued on page 97)



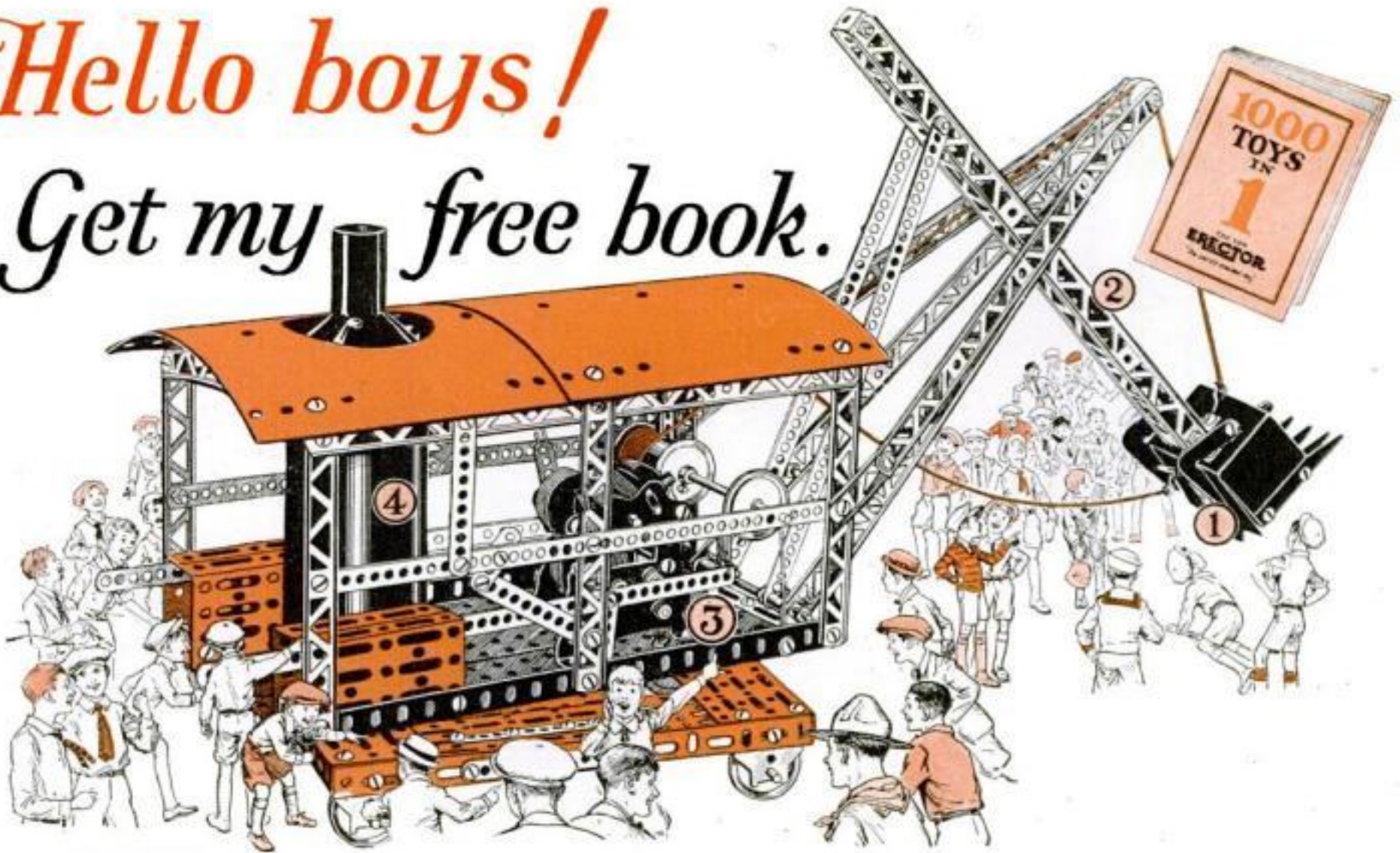
Flowing lacquer on a door panel. The brush is kept well filled so that the bottom of one stroke will flow smoothly into the top of the next stroke. At right—Applying the first coat to the hood with gratifying results





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# An Automatic Block Signal System

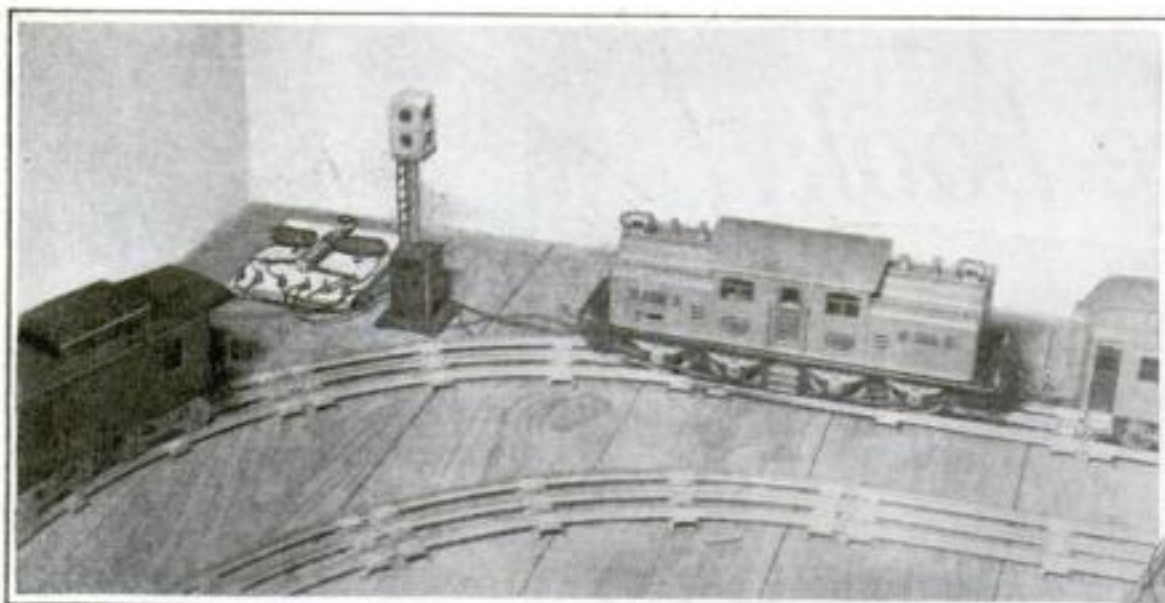
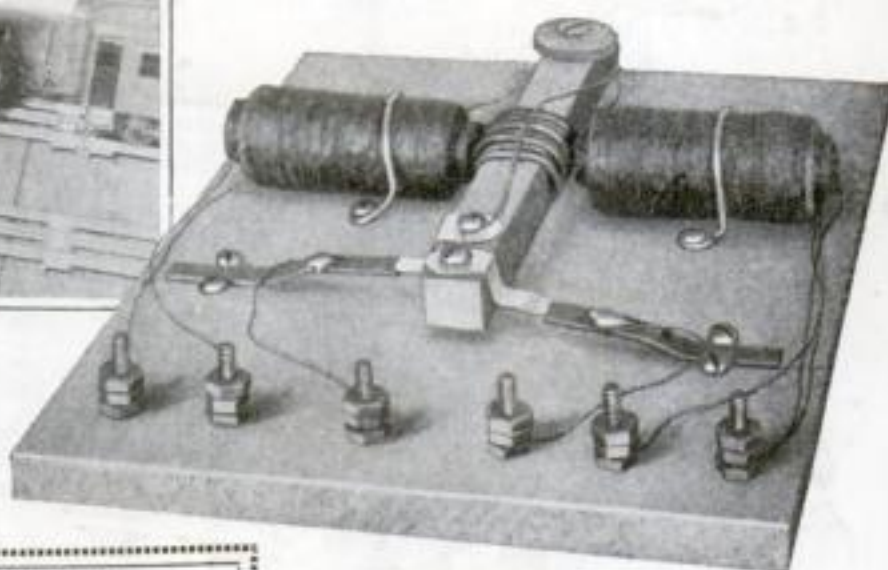


Fig. 1. With amazing realism, the model train comes to a full stop when it is about to overtake the train ahead, and later goes on by itself

Fig. 2. (At right) A "close-up" of the electromagnetic switch which controls the trains. The simplicity of construction can be noted at a glance



*It's Easy to Add This Novel Accessory to a Model Electric Railway*

By JAMES A. BAKER

A LARGE part of the fascination of model electric railways lies in operating them in as realistic a manner as possible. The numerous factory built accessories are a great help in obtaining this effect. Crossing gates that close and open as the train goes by, switches electrically controlled by buttons, and countless other details can be added, piece by piece, until you have a marvelously complete system.

Yet in spite of the amount of apparatus available, it is still impossible to buy a real automatic block signal system—one that actually will control the operation of two trains running on the same track and prevent a rear-end collision if one of the trains happens to be traveling at a greater speed than the other.

You can buy a thermostatically controlled train signal that will stop a single train for a few seconds and then allow it to proceed as the signal lights change from red to green, but this device will not stop a following train and prevent a collision. For the model railway owner who has only one locomotive it is satisfactory, but if you have two locomotives something more is needed.

WHAT you want is a real automatic block signal system and the construction of such a device is extremely simple. In fact the control device shown in the illustrations on this page was put together in one afternoon with no tools to work with other than a small wood saw, a pair of wire-cutting pliers, a gimlet, a screw driver and a soldering iron. And the soldering iron was not really necessary.

The wiring that completed the installation also was finished the same afternoon and after proper adjustment, the block signal system worked without a single failure for over six months until an exceptionally bad spell of damp weather last summer caused the wooden arm to swell and necessitated a touch of the screw driver to loosen up the friction on the arm. It is still in operation,

## Can You Work This Out?

HERE'S a little problem for you. The automatic block signal system described in the accompanying article is intended for trains running only in one direction. Can you make a wiring diagram to show how the system may be connected up by means of electric switches so that it will work no matter in which direction the trains travel? Send in your solution before December 31, 1926. The best solutions will be published and paid for at the rate of \$5 each.

and those who have watched it work have marveled at the sight of two trains running continuously around and around on the same track with no attention. When the faster train creeps up too close behind the other it is stopped in the block until the front train regains its lead. To the observer it is so realistic that it almost seems as if there must be a tiny engineer in the cab with his hand on the throttle.

The heart of the automatic block signal system is the electromagnetic switch shown in Fig. 2. It has been made just as simple as possible so that you can build it with the tools found on almost

every home workbench. You can improve the crude appearance and workmanship as much as time and facilities will permit as long as the basic principle is not changed.

No alteration is necessary in the design or construction to allow for different types of current supply or voltage. It has been tested on both alternating and direct current at voltages from 6 to 21 and it works perfectly without even a change in the friction adjustment. That means, of course, that you can use it on any of the miniature electric train systems sold today.

The electromagnetic switch consists, essentially, of two electric magnets placed on opposite sides of a movable wooden arm. On the arm are mounted metal contacts arranged to touch other contacts fastened to the wooden base.

Fig. 3 shows a wiring diagram of the complete installation, which consists of the electromagnetic switch illustrated in Fig. 2, a signal tower for the red and green lights (Fig. 1), and the two track contacts A and B (Figs. 3 and 4).

Current is sent through the windings of the magnets by way of the contacts A and B, which are placed between the rails so that the collector rollers on the electric locomotive will bridge the gap between the third rail and either A or B.

THE first job is the construction of the electromagnetic switch. Study Figs. 2 and 3 very carefully before you start work. The base is made of a piece of board approximately  $\frac{1}{2}$  by 6 by 7 in. It would be possible, of course, to make the whole control on a base measuring less than 2 by 3 in., but that would require extremely careful workmanship and there really is no need for a small switch as this unit can

(Continued on page 106)

Turn to page 74 for the continuation of the Home Workshop Department.

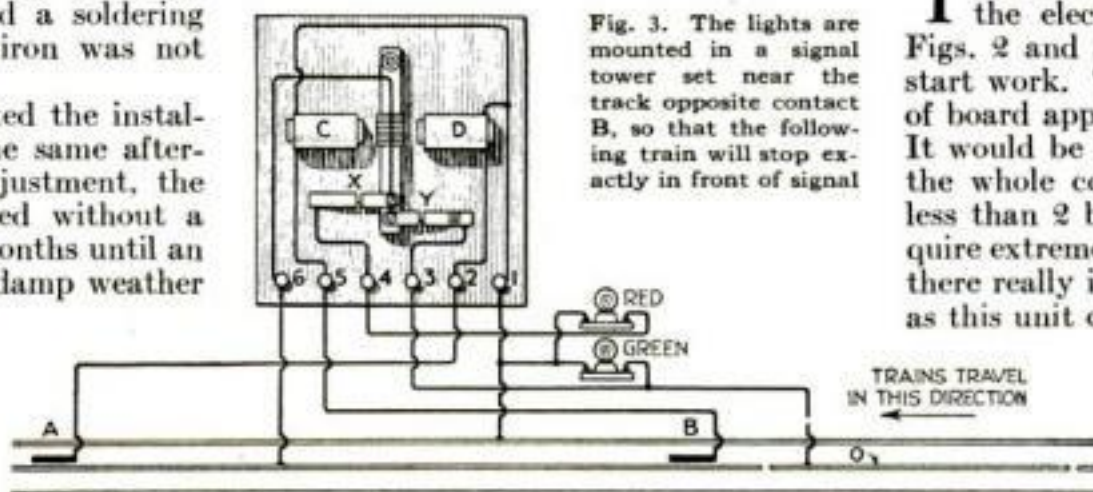
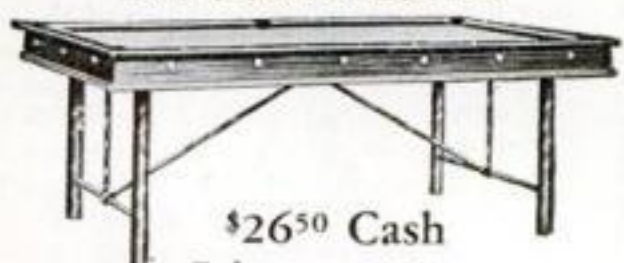


Fig. 3. The lights are mounted in a signal tower set near the track opposite contact B, so that the following train will stop exactly in front of signal





"The PLAYMATE"



\$26<sup>50</sup> Cash

Balance on easy terms

A modified standard billiard table, size  $3\frac{1}{2} \times 7$  ft., with folding legs. Has genuine slate bed and all playing qualities of the professional size table, cushions, angles and balls being scaled down with scientific precision. Comes complete with full playing equipment. At a slight additional cost interchangeable cushions may be had making it available for either carom or pocket billiards.

Smaller tables for pocket billiards only, sizes  $2\frac{1}{2} \times 5$  ft. and  $3 \times 6$  ft., may be had at still lower prices.

## Make This Christmas The Best Ever

### Have Dad Give You a Brunswick Home Billiard Table

**N**O game will provide more genuine pleasure, more fascinating entertainment, more lasting enjoyment than a Home Billiard table. It is the greatest gift of all—and lasts for years and years.

Right now is the time—of all times

#### Brunswick Home Billiard Tables Are Inexpensive

A small initial deposit brings one to your home in time for Christmas. The balance may be paid as you play. No extra space or special room is needed for the newest Brunswick Home Table

—to obtain one. For billiards is a sport that you and everyone you know can play and enjoy. And the more you play it the more interesting it becomes. It is splendid exercise, does you good both physically and mentally. Develops judgment, clear thinking and coolness.

—the Playmate. And there are a number of other attractive models.

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# Better Shop Methods

*How Expert Mechanics Save Time and Labor*



## Machine Keys—How to Fit Them

*Straight, Tapered and Woodruff Types—Ways to Remove Them If Badly Stuck—The Time-Saving Kinks of Old Bill*

By JOE V. ROMIG



Fitting a feather key. To do a really good job always calls for more than general experience and average care

**M**ACHINE keys couple together our shafts, gears and pulleys, harnessing our greatest servant, power.

The standard shapes and kinds of keys are well-known to most mechanics, but many interesting points sometimes are overlooked in regard to them. Keys are fitted into milled or slotted grooves in the two parts to be fastened together; they may have plain or gib head ends, and they may be straight or tapered. Simple enough, it's true, yet to be able to fit any one of them properly has always been a test of mechanical skill.

When driven tightly home, a correctly seated key that is large enough to drive its load will also hold the gear or pulley in place on the shaft and prevent its slipping.

A straight key generally is used in connection with one or more set screws and needs only to be a light tapping fit on each side, because these two faces are in frictional contact with the keyways. This type of key allows pulleys and gears to be disassembled with ease. Plain taper keys are fitted so as to have a light driving contact on both sides and a perfect fit on top and bottom.

**W**HEN a taper key is to be used in an inside position on a shaft, it is obvious that the keyway in the shaft must be cut twice the length of the key so that the key can be driven home from one side or the other of the pulley or gear. If the key is to be straight in this construction, it can be made to slide with a light frictional contact on the sides and, after it is in position, it

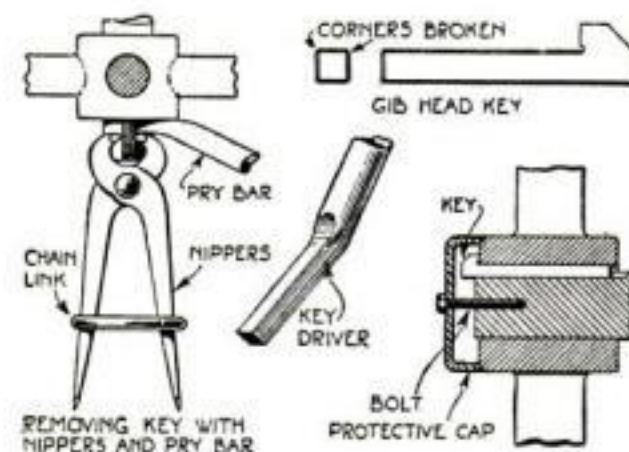
can be held firmly with set screws. When the pulley or gear is close to a shoulder, it is not advisable to use a taper key unless there is room for a head on the outside. Otherwise it would be very difficult to withdraw the key after it had been driven hard into its seat. Seldom can any provision be made in the design for withdrawing a taper key in this position other than using the gib key, but it is not always possible to use this type of head.

Gib keys are generally used in end positions on shafts. Keys that must be driven tightly on account of unusually heavy loads should be preferably gib keys, as the head provides a means of withdrawing them more easily when repairs have to be made.

Where a taper key must be driven hard, it is good practice to give the ends a generous bevel and the fit should be emphasized on top and bottom rather than on the sides.

The standard taper for keys is  $\frac{1}{8}$  in. a foot; in practice, however, it is not always possible to hold this taper true. Any variation from the standard may be compensated for by fitting the key to the taper which has been cut in the pulley or

gear. In doing this, both ends of the keyway are calipered and the top of the key planed or filed down to correspond. Another good way is to make a dummy key either of lead or hard wood. When the dummy is cut down somewhere near the right size, it may be driven into the key seat and driven out again. It will then serve as a model for making the key.



Gib key, key driver or drift, a safety cover, and a satisfactory method of removing a key

In former years it was customary to forge gib keys or shape them out of rectangular stock, but now the commercial keys are so nearly the proper size that a few minutes' work with the file is all that is necessary in fitting them.

Commercial keys may be obtained in rough or finished sizes. The rough keys are usually from  $\frac{1}{32}$  to  $\frac{1}{16}$  in. oversize and are intended to be finished by hand. These come in handy for making up special keys or fitting one where the keyway has been worn or cut larger than standard. Finished keys require little fitting if the keyway has been carefully cut.

When fitting a key a lubricant should be used. A telltale is also necessary to aid in indicating exactly where the key is bearing in its seat. To serve this double purpose, white lead mixed with machine or lard oil is excellent. The mixture should be about the consistency of thick cream. *(Continued on page 124)*



Removing a key with a drift. It is well known by all machinists how troublesome a stubborn key can become

**M**ANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, on pages 119 to 128.





## **“Where’s your combination square?”**

Any man that’s ever worked with a Starrett Combination Square can’t see how it’s possible for anybody else to try to get along without one.

And they are—those No. 94’s—just about the most useful tool in the chest. They replace seven separate tools—square, miter, height, depth and marking gages, rule, level and plumb—and they’ll do the work of each just a hair better than the original tool would do it.

If you haven’t a Starrett Combination Square in your chest now, your nearest good hardware dealer has one that he’ll part with—for a consideration. And it’s worth it. It’s also worth while writing us for a free copy of Catalog No. 23 “W.”

Starrett  
No. 94 Combination  
Square

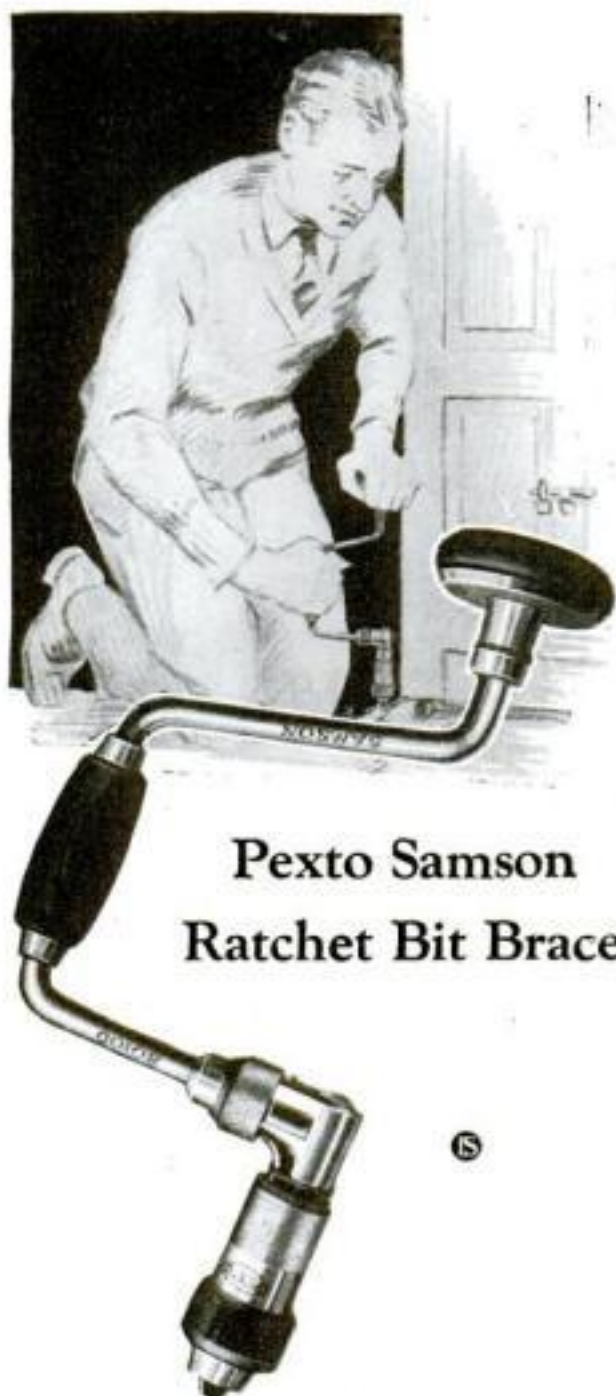
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Manufacturers of Hacksaws Unexcelled  
Steel Tapes—Standard for Accuracy  
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276

# Use Starrett Tools





**Pexto Samson  
Ratchet Bit Brace**

**F**OR the mechanic and for general home use, the Pexto Samson Ratchet Bit Brace, illustrated above, will give a lifetime of dependable service and stand up under the severest "roughing." Its ball-bearing chuck gives the Pexto Brace a grip that never lets go. It will hold round, square or taper-shank drills. The Samson is the kind for you—it's a boon to the "home mechanic."

PEXTO TOOLS are carried by practically all progressive dealers

Write for Booklet

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Southington, Conn., U. S. A.



**Worth While  
TOOLS**

## The Home Workshop



When there are children in the family, a popular Christmas table centerpiece is one representing Santa Claus and his reindeer

## How to Decorate for Christmas

*Brilliant Window Effects—Lighting the Lawn—  
Doorways and Stairs—A Table Centerpiece*

By CHARLES M. MILLER

**C**HRISTMAS decorations of the most original, appropriate and interesting kind are not those bought ready-made in the rush and hurry of last-minute shopping, but those prepared in the home with the merry co-operation of every member of the family.

All sorts of ideas can be worked out, as simple or elaborate as you please. In no case is it likely that every one of the suggestions to follow will be carried out in the same home the same year. An effort should be made, however, to develop the decorations a bit more than has been customary in previous years.

The home decoration may be subdivided as follows: lawn, porch, windows, Christmas tree, lighting fixtures, arches and doorways, open stairway, and, last but not least, the dining table.

Starting with the newer feature of Yuletide recognition, let the lawn be illuminated at night during Christmas week. If an evergreen tree is growing there, an electric cord can be run from the nearest socket and two or three strings of lights hung on the boughs. A breaker or flasher inserted in each of the strings adds to the effect, especially if the strings cross and recross.

On other trees hang red lanterns. These may be lighted by electricity or with candles. Homemade lanterns are more appropriate than Oriental. The use of cartons for lanterns simplifies the problem. They should not be large, not over 8 in. to a side.

Cut opening designs in the sides of the boxes and paste red paper over the entire outside of the lantern. Crêpe paper is best, as the color is stronger and yet softer in effect, but it should not be stretched.

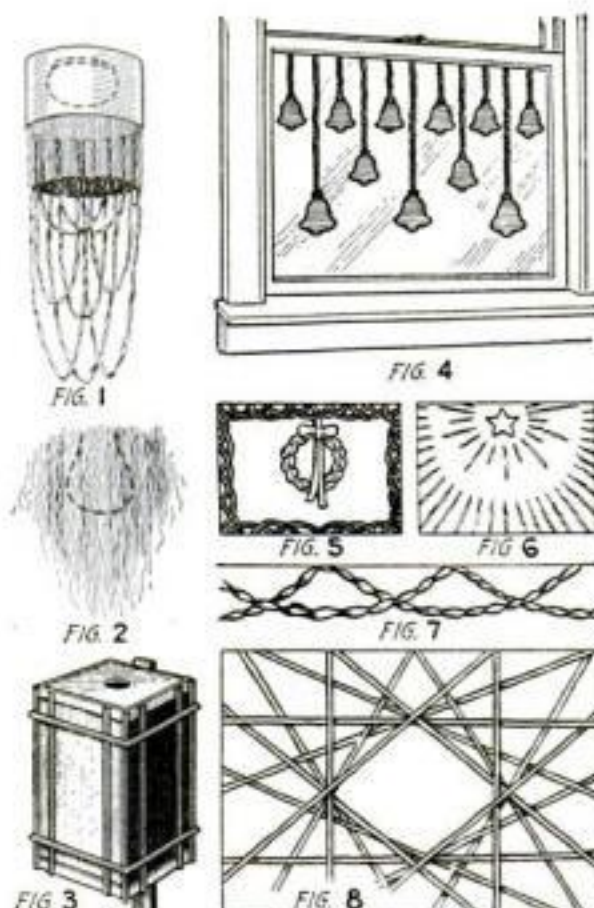
Another idea is a box lantern (Fig. 3) attached to a stake driven into the ground, if it isn't frozen too hard. A light framework with a wooden top and bottom is satisfactory.

**T**HE porch decorations may include some of the lawn features, but festooned streamers are, perhaps, more fitting. An overhead porch light may be inclosed in such a way that all but the downward rays are cut off. Below this housing drop a great many loops of narrow, bright colored strips of paper and some silver and gilt strips as well to give an effect similar to that in either Fig. 1 or Fig. 2. Gloss coated, colored papers such as are used for boxes are good for this, but narrow strips of crêpe paper are more transparent.

Thrilling effects in color are possible if there is snow on the ground. Three or more colored spotlights may be improvised and thrown so as to mingle the different colors on the white surface.

Window decorations may have many motifs. The sil-

(Continued on page 76)



Decorating the porch light, a lawn lantern, and various methods of ornamenting windows



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Another striking number in the new series of Lionel Freight Cars. A real oil car in miniature.

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**LIONEL STANDARD OBSERVATION CAR Showing Dome Light and Best End Locomotive**

"STANDARD OF THE WORLD SINCE 1900"

# LIONEL ELECTRIC TRAINS

MODEL RAILROAD ACCESSORIES

## "MULTIVOLT" TRANSFORMERS



# The Home Workshop

## How to Decorate for Christmas

(Continued from page 74)

houettes suggested for lanterns may be developed on a much larger scale. Some windows require only a plain holly wreath with a bell inside. A window or two may have an open curtain effect made with ribbons of crêpe paper and bells, as in Fig. 4.

In Fig. 5 the curves of the paper rope are held in place either with wire or basketry reed.

Stars, large and small, may be used effectively on a window, as in Figs. 6 and 9. The rays are formed with tinsel cord. A common kitchen cleanser that

signs. In swinging long festoons, it is best to have one end of each curve higher than the other, as in Fig. 11. In other words, the curve should not be too regular, as in Fig. 7, except across small openings.

A simple treatment for a plain doorway is shown in Fig. 10. The 3 in. wide red hangings at each side have cross bands of green; the top is green with a red stripe.

**T**HE best place for the Christmas tree usually is in a corner of the room. All sorts of bases can be made. Perhaps the simplest is that shown in Fig. 12.

The decoration of the Christmas tree has been developed to such a fine art these days that no directions need be given here.

As the tree appears to best advantage when lighted, the practice in some homes is to leave the shades drawn on Christmas morning and use artificial lighting during the distribution of the gifts. The effect is enhanced if the ordinary lamps in the lighting fixture are replaced with globes that have been dyed red and green.

An open stairway offers a splendid opportunity for decoration. A large candle may be mounted on the newel post, as in Fig. 13. This is a cardboard roll covered with bright red paper. Some real paraffin at the top and a large wick give a realistic appearance. It is still better to use an electric candle-flame bulb.

For Christmas dinner the white tablecloth may be decorated with a red crêpe paper band about 2 in. wide applied about 3 in. up from the lower edge of the drape. Four similar bands are run across the top of the table about 1 ft. from the edges and parallel to them.

An alternative method is to use a 12 in. wide strip of red across the center of the table and a similar strip lengthwise.

A green rectangle of crêpe paper makes a good foundation for the centerpiece. On this use cotton for snow, with a generous sprinkling of artificial snow.

When there are children, a reindeer and Santa Claus centerpiece, as shown at the top of page 74, is especially appropriate.

Six small composition reindeers, about 3 in. high, are placed in pairs, with ample room between the pairs. If a cardboard sleigh cannot be found, one can be made of red paper, as suggested in Fig. 14.

**A** COMPREHENSIVE article on how to set up a Christmas tree, keep it fresh and make the decorations was published in the December, 1925, issue of POPULAR SCIENCE MONTHLY; another article in the same issue told how to prepare a Yuletide decoration for over the mantelshelf. A method of concealing the base of a Christmas tree with a glittering snow mountain was the subject of a long article in December, 1924. Either one of these issues may be obtained, so long as the supply lasts, by sending 25 cents to the Circulation Department of POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York.

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a wonderful new ATKINS  
"Silver Steel" Hack Saw  
Blade for hand use. Tests  
show it will cut six times as  
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# ATKINS SILVER STEEL SAWS

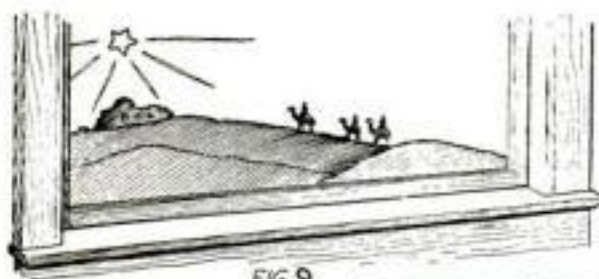


FIG. 9

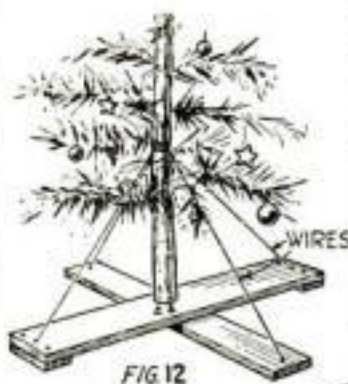


FIG. 12

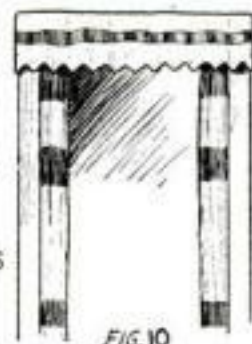


FIG. 10



FIG. 13



FIG. 11

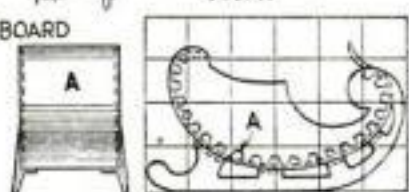
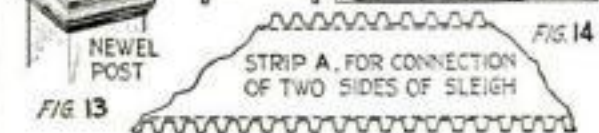


FIG. 14



Arch, window, door and stair decorations,  
a simple tree stand, and a miniature sleigh

leaves a white deposit on glass can be used for cloud effects.

A window may be covered with green Christmas wrapping paper, in which stars have been cut out, and pieces of colored gelatin, such as may be obtained at motion picture supply stores, fastened to the back of the stars with rings of paper.

For a design such as Fig. 8, start at one corner sticking on strips of paper about 1/2 in. wide; use mainly red strips with a few green, or vice versa. Some fine tinsel distributed rather carelessly over the strips will add life to the design. There are endless possibilities in such an arrangement of paper. A spider web may be made with narrow strips.

Arches and doors call for festoon de-



—and at WCAE, the Great Pittsburgh Broadcasting Station of Kaufmann & Baer Co.—

they use a Day-Fan Radio Receiver in their Listening Room to judge their Programs—



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Day-Fan Radio Receivers, as used in the broadcasting stations and in thousands of American homes, are five, six, and seven-tube; priced from \$39.00 to \$150.00; table and console models; bringing in stations at their newspaper numbers on the single dial control.  
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### Do Away With Local Interference

No, not all the noise in your radio is caused by static. Most of it is local, caused by your own small household appliance motors through the house wires. These noises go direct to your set, spoil your entertainment, and get blamed as "static."



Quietus, which has nothing to do with the set itself, is a Day-Fan accessory which stops these noises before they reach your set. Improve the clarity of your reception—write us for information on Quietus.

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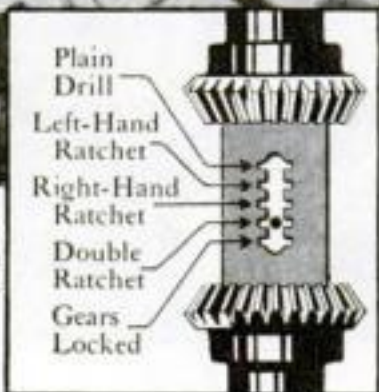
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Name \_\_\_\_\_ Address \_\_\_\_\_ State \_\_\_\_\_





A finger touch on Ratchet Shifter gives any one of five adjustments.



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WITH "Yankee" Ratchet Breast Drill No. 1555 set on DOUBLE Ratchet, any slight movement of the crank, either back or forth, lets you drill continuously.

Think what this means when you have space for just a half turn—or only an inch. Nothing need be removed. No lost motion. No lost time.

The four other ratchet adjustments shown above, and two speeds, make this "Yankee" Drill the handiest and fastest ever designed.

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Ratchet Breast Drill No. 1555 (Illustrated), 3-jaw; No. 555, 2-jaw. Hold  $\frac{1}{2}$  in. Drills. Ratchet Hand Drill No. 1545, 3-jaw; No. 545, 2-jaw. Hold  $\frac{3}{8}$  in.

For smaller drilling jobs use "Yankee" Ratchet Hand Drill No. 1530, with five ratchet adjustments.

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#### "Yankee" Christmas Suggestions

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Dealers everywhere sell "YANKEE" Tools.

"Yankee" on the tool you buy, means the utmost in quality, efficiency and durability.

NORTH BROS. MFG. Co., Philadelphia, U. S. A.

# "YANKEE" TOOLS

Make Better Mechanics

## The Home Workshop

# Making a Picture Frame with FEATHER JOINTS

By EMANUEL E. ERICSON, *Noted Manual Training Authority*



1 (At left) Square up and face-mark the wood; set rabbet plane for depth; then rabbet can be cut



3 (Above) Gage for slip-feather slot by running gage against the under side. Mark each end of each piece, placing gage line in the middle of the edge

2 (At right) Cut one end of each piece at a 45-deg. angle in miter box; measure each piece in the rabbet; miter the other ends



4 Place an identification mark on the joints that are to go together and clamp each joint in the vise between two pieces of soft wood, after which cut the slots with a rip saw



6 When glue is dry, it is time to trim "feathers" with chisel and plane

5 Prepare slip feathers of veneer or thin wood and insert one in each joint, after gluing both joint and feather. Test frame with square and set aside to dry



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WITH four times less drain on your "A" batteries than the storage battery tube of five years ago, the filament of a Radiotron UX-201-A throws across to the plate five times as many electrons—a steady stream of tiny electrical charges that carry the song and speech. This is a big increase in efficiency!

And the Radiotron UX-201-A does not burn out—unless you apply a huge, excessive voltage. It does not die gradually, but keeps its efficiency almost to the very end of its life.

These are but a few of the advances in vacuum tube making that have come from the laboratories of RCA and its associates—General Electric and Westinghouse. Unceasing research brings continual improvement in RCA Radiotrons, making possible ever better reception—at lowered cost.

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put an RCA power Radiotron UX-120, UX-171 or UX-210 in the last audio stage of your set.

## to get more distance

(on a storage battery set)

—put the new special detector Radiotron UX-200-A in the detector socket.

RCA is not only making Radiotrons steadily better—but is further improving reception with these new special Radiotrons. Keep your set up-to-date.



# RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA



## "Putting Over Open D"

AERO-B



THE Aero B Amplipower makes possible on your radio the exact reproduction of every note of every instrument. Deep resonant bass notes that are the heart of real music are brought to life with all their richness of tone. When the bass viol booms out its low D the Amplipower will push it through your loud speaker with the deep, resonant clarity of the instrument itself.

The Amplipower will make the tone of your radio as much better as the tone of the new talking machine is better than the old, if your set and loud speaker are of the better kind.

The Amplipower supplies all of the "B" current for the set, as well as the A, B and C voltages for the built-in high voltage power tube that makes possible greatly increased volume with absolute fidelity of



tonal reproduction—both instrumental and vocal. Can be attached to any set in a few minutes, in the same manner as "B" batteries.

Price \$65.00 without tubes. If your dealer hasn't the Amplipower or Aero B power unit, write us.



Aero B is also built as a "B" power unit without the high voltage power tube—price \$50.00 complete.

THE GLENN L. MARTIN COMPANY  
Radio Division • Cleveland, Ohio

**AERO-B**  
Amplipower and  
"B" Power Units

## The Home Workshop

### There's Fun in Painting Toys

*How to Obtain a Professional Finish, Smooth and Brilliant—Materials and Colors to Use*

By BERTON ELLIOT

"THERE'S nothing like doing your Christmas shopping early," laughed Mrs. Andrews, pointing to one of the packages she was carrying. It had been broken open a bit as she entered the crowded bus and something red and shiny was visible through the torn paper. "I've got one of the cleverest mechanical toys you ever saw," she confided. "I bought it at one of the little shops along the avenue. You know, we hadn't expected to buy any toys this year. John's been making 'em. Ever since he began reading POPULAR SCIENCE MONTHLY he's been making all manner of things, and they most all turn out well."

"Yes," she continued, hardly stopping for a breath, "we've got it all figured out. The toys our kiddies got last year we're going to paint up and give to a hospital. They will be just the same as new to the little boys and girls who haven't played with them before, and our kiddies will have some wonderful new playthings to take the place of those they have outgrown or become tired of."

"I'm going to paint the ones we give the hospital, but John says the ones he has been making are his babies, and he wants to do every stroke on them, from first to last."

"But do you know,"—lowering her voice—"we're a little bit afraid of the painting part. It seems simple enough, but I've seen some homemade toys that looked crude and amateurish, due more to the poor painting than to anything else. And Cousin Frieda said it was a slow job—hard to keep the kiddies from discovering the toys while they were setting around until dry."

"Well, Mrs. Andrews," I responded, "you and John drop over this evening, and I'll give you some pointers. There really isn't very much to it, but like everything else you want to do it right."

Later on, just as we were finishing the evening paper, the Andrews came over.

"Now, about painting toys," I began, after we had exchanged a few remarks about other things of casual interest. "There are several different kinds of painting materials you can use. The one that has been most generally used is auto enamel. It has a rich luster, comes in

the brilliant colors that are popular for toys, and can be obtained in small cans. It is also a little more tough and durable than the usual decorative enamels, and will stand better the extremely hard wear children give toys.

"Then there are the new brushing lacquers. As a matter of fact, they are better adapted for finishing toys than any other material. They dry in a few minutes, so you can get the job done and the toys wrapped up and put away before the kiddies have a chance to come across

them. There's another thing: kiddies always try to put everything in their mouths and lacquer dries with a flintlike surface which will not be softened up and come off when moistened. It cannot even be scratched off easily by sharp little teeth. And besides, it is perhaps the most durable type of finish. You know the sprayed lacquer finish on automobiles can hardly be scratched with a nail. Brushing lacquer will probably be the best material for you to use—and the most fun."

I pointed out that in the past, before the advent of brushing

lacquers, a finishing material sometimes used to speed up the work was white shellac colored with dry colors. This mixture dries in an hour or so. The powdered colors are obtainable cheaply at almost any paint store, and many who have had good results with this mixture hesitate to try anything else.

"I guess we'll use lacquer," commented Mr. Andrews, and Mrs. Andrews nodded assent.

"The colors," I continued, "probably have more to do with the homemade look of some toys than anything else. Toys that you buy in the stores are usually finished in bright red or bright yellow. Children are attracted by these brilliant, warm colors, and toy manufacturers have found that where other colors are used their product does not sell. Therefore, when home toy makers use other colors, the toys don't look natural, and consequently seem crude and awkward. Another important thing is the proper balance of color. One color must predominate and the trim color must be put on in about the right



Bright red and yellow, in either enamel or lacquer, are the favorite colors for Christmas playthings

(Continued on page 104)



# Swifter, finer tuning action— *Illuminated*



Striking beauty,  
as well as micrometer accuracy, distinguishes the receiver equipped with MARCO controls.



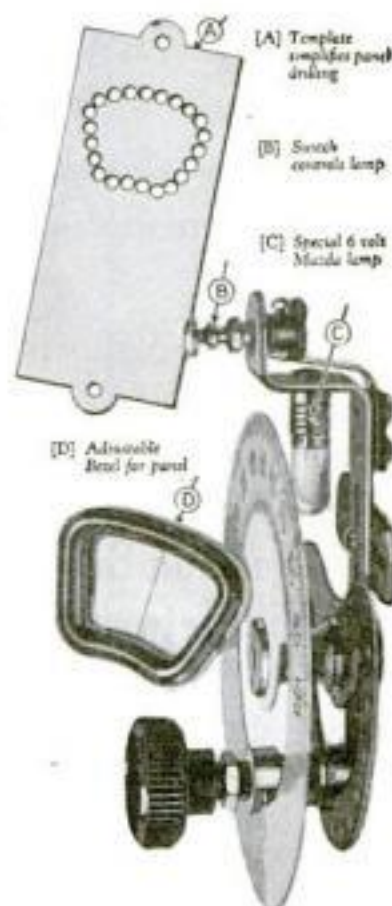
Actual Size

## Responsive— to your lightest touch

ORDINARY dials seem clumsier than ever. . . still more inadequate to meet modern conditions . . . after one experience with the new MARCO control. Nothing approaches its swift, searching response except the celebrated MARCO vernier dial itself, 500,000 of which have replaced old type dials. But the new control develops the "friction-drive" principle to the utmost, banishing any suggestion of "backlash" or play. And when you switch on the light, a soft radiance illuminates the moving numerals, adding swifter readability to the scale . . . and fascinating beauty to the panel.

MARCO controls fit all condensers. Scales read 0 to 100, or 100 to 0, as preferred. The template supplied reduces panel mounting to a simple 10-minutes' diversion, whether you are building a new set, or remodelling an old one. The special Mazda lamp runs on your regular "A" battery or on a separate "C" battery. Send for Booklet. Martin Copeland Company, Providence, R. I.

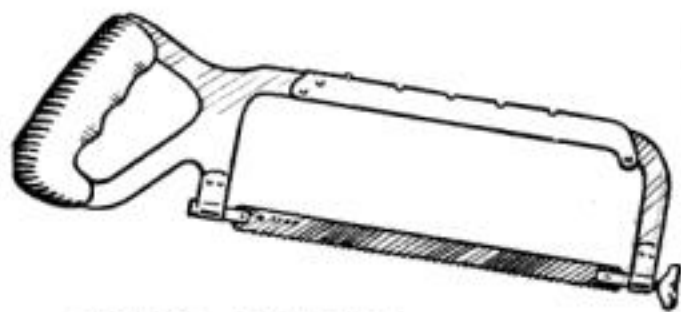
MARCO illuminated Controls, \$3.50 each  
MARCO 4 in. vernier dials  
(fit any set) nickel plated, \$2.50  
Gold plated, \$2.75  
New MARCO rheostat dial . . . 75c



# MARCO *Illuminated* Controls



## Skilled Labor is dependent on Good Tools



**AND THEY  
RELY ON  
STAR BLADES**

The new Star Special Flexible Blade, produced after 43 years of intensive research and development work, combines unusually flexible qualities with the cutting efficiency that has made these blades famous.

Tell us about your cutting problems and we will furnish you with sample blades that will meet your requirements.

**Clemson Bros., Inc.  
Middletown, N. Y.**

MAKERS SINCE 1883

# STAR HACK SAWS



## The Home Workshop

### How to Utilize Your Cellar

*One Man Built a Basement Greenhouse—  
Other Ways of Using Waste Space—  
A Symposium by Our Readers*

**W**HETHER or not you are making full use of the cellar in your home, you will be interested in reading about some of the profitable and ingenious ways in which readers of POPULAR SCIENCE MONTHLY have utilized the basement space that is so often wasted.

The suggestions that follow were selected as the most practical from the

many sent in by those who read the article "How to Utilize Your Cellar," in the April issue, and "How I Improved My Cellar by Making a Coal Vault," in the May issue.

While only two letters are published in regard to the use of cellar space for a workshop and in connection with gardening, a large number of contributions dealt with the subject.

By W. E. PYKE, Colorado Agricultural College

**T**HERE are hundreds of thousands of plant lovers in this country who can get a tremendous amount of enjoyment by building a set of greenhouse frames just outside one or more of their cellar windows.

Select, if possible, the side of the house that will receive the most sunlight during the winter months, bearing in mind also the direction from which the cold winter winds generally blow.

The ground should drain gently away from the frame on all sides. The front and ends should extend far enough into the ground to keep out winter frost, and the earth should be drawn up around the front and ends as a further insulation.

The top of the frame should be built rigidly and arranged so that it can be tightly closed in inclement weather and at night. If glass is used it should be inserted as in a greenhouse or skylight. The writer prefers to use either glass cloth or a commercial celluloidlike product and has found them more satisfactory.

An additional cover must be provided where the weather is as severe as it is in the northern Mountain States. A blanket or comforter made of old woollens or cotton bats arranged as loosely as possible and covered with canvas on the upper side should prove satisfactory. If made in sections, the sections should be overlapped liberally.

The heat for the writer's frame is provided by keeping the basement windows that open into the frame wide open. The plants of the more hardy type may be bedded right in the frame, while those requiring special care are started in the

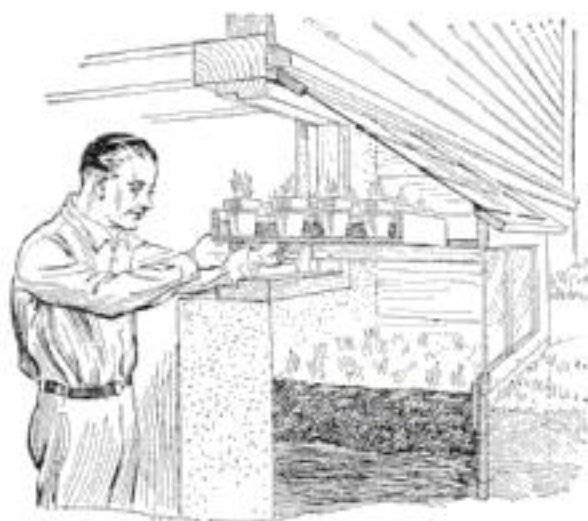
usual uniform trays, which are brought into the basement through the windows at night and in severe weather. When the plants become large enough for potting, the pots are placed in trays made to fit the frame for convenience in handling. These trays contain a layer of sand to insure perfect drainage and to hold the pots more or less firmly embedded.

For soil requirements, one should have a box of good loam, a supply of well-rotted sheep manure or leaf mold, and a supply of sand. Many books can be obtained dealing with this subject. Suffice it to say that if the right methods are employed success will be attained, but the writer would not advise anyone who is not a lover of plants to try the experiment.

Small vegetables such as radishes and head lettuce can be grown easily. Flower plants suitable for pot culture in the house can be started in the frame and a wealth of bloom can be had in the house every month in the year. Moreover, bulbs for winter bloom can be started in the early spring from seed. The bulb can be brought to maturity in the early summer and given its period of rest during the remainder of the summer. The bulb then may be potted up in the fall for winter bloom.

In localities where the growing season is short, hybrid roses may be purchased from the greenhouses and gradually acclimated in the spring so that they will not lose their leaves when set in the open ground and a much longer period of bloom will be realized the first year.

There are many flower plants that may be started in the frame during January and February (Continued on page 111)



A wealth of bloom every month in the year is insured by this cheaply-built greenhouse





Send for our  
**FREE BOOK**  
on care and upkeep  
of Radio. It will  
help toward getting  
better reception.



**H**ERE are a few suggested Sterling gifts for making someone merry at Yuletide.

And for months thereafter, the owner of the Sterling device you presented, will realize you helped make better reception his pleasure. Each Sterling Radio Care-Taker or Inspector plays a prominent part in reducing troubles, simplifying service and adding to the convenience of the set owner.

Remember, too, that the radio product bearing the Sterling trade-mark is like the piece of silver stamped "Sterling"—good all the way through.

We suggest you see your dealer for your selection of Sterling radio devices or write immediately for our interesting 32-page booklet showing the complete line.

**The Sterling Mfg. Co.**  
Cleveland, Ohio

# Sterling

## Care-Takers and Inspectors of Radio Sets

### Sterling Tube Reactivator No. 403

Meter equipped. Insures lasting high quality performance from tubes—large or small. A money saver as well as a promoter of efficiency. Price \$12.50.

Midget Tube Reactivator (without meter). Price \$3.75.



### Sterling "B" Power

No. 97, for "B" and "C" power, has far more advantages than merely an eliminator of batteries. Delivers up to 180 volts at 50 milliamperes, is especially desirable for No. 171 and 210 power tubes, and has new type improved Raytheon tube. Price R-97 "B" and "C" Power, \$55.00.

Price R-99 "B" Power \$45.00.



### Sterling Home Tube Tester No. 411

Immediately shows whether tube is good, fair or poor. No computations to make. Price \$7.50.



### Sterling Charge Indicator No. 32

The clean, easy external test for storage "A" batteries—shows when battery needs charging and when it is charged enough. Price, \$2.00.



## IF YOU CAN USE AN EXTRA \$20.00 BILL

write for  
this

## FREE BOOK

YOU can save  
\$20.00 in no  
time by using



## SMOOTH-ON No. 1

to do your own household repairing—and in addition you will have that proud "I-did-it-myself" feeling.

Here is what one enthusiast did with two 35 cent cans:—A \$25 lamp stand loose in base, two big leaks in heating furnace smoke pipe, loose hammer handle, and three loose hooks in tiled bath room wall were all put into good usable condition at an average cost of 10 cts. for each repair—and \$20.00 easily saved over what would have been paid to professional fixers or for new parts.

By using Smooth-On to make dozens of the simple repairs necessary in every home, you can save enough to pay your radio upkeep, buy yourself or your wife a camera, a bull pup or some other pleasure giving article that you would otherwise hate to spend the money for.

### On the Automobile

Smooth-On No. 1, being unaffected by water, oil, gasoline or heat, is also excellent for automobile repairs. Try it for stopping radiator, tank, pipe line and hose connection leaks from the outside, keeping exhaust line connections tight to prevent the escape of obnoxious burnt gases, repairing cracked water jackets and crank, gear and differential cases, keeping grease cups, lubricator connections, nuts and hub caps from loosening and falling off, tightening loose hinges, robe rails, etc.

### The FREE Smooth-On Repair Book

will show you how an astonishing number of home and automobile repairs are as easy for you to make as for somebody else.

Mail the coupon for a free copy and get Smooth-On No. 1 in 7-oz. or 5-lb. can from any hardware store—or if you want us to send a sample 7-oz. can, enclose 35 cts. in postage stamps when you return the coupon.



**Smooth-On Mfg. Co.**

Dept. 58, 574 Communipaw Ave.  
JERSEY CITY, N. J.

**Do it with SMOOTH-ON**

SMOOTH-ON MFG. CO. Dept. 58,  
574 Communipaw Ave., Jersey City, N. J.

Please send the free Smooth-On Repair Book.

Name.....

Address.....

**Return this coupon for a  
FREE copy of Booklet**

## The Home Workshop



Mr. Thatcher at the lathe in his workshop. He developed tin can toy making as used in reconstruction work for wounded soldiers

## You Can Make Delightful TOYS from Old Tin Cans

By EDWARD THATCHER

WHEN my boy was about two years old, I searched the toy shops for a large tin locomotive such as I remembered having had when I was a little chap. Failing to find one, I thought of certain tin cans I had saved up. There was a long cylindrical biscuit tin, which would do nicely for a boiler; an adhesive tape box would make a funnel or smokestack, while a square olive oil can would serve for a cab, and flanged syrup can lids would make realistic wheels.

Here was an idea! I hurried home from the toy stores and set to work in my small shop. In an hour or two I had the locomotive made, much to the delight of my small boy. It looked the part; moreover, it was strong, and after many a clattering trip over the sidewalks of New York, we still have it.

At that time our whole college (Teachers' College, Columbia University) had been turned over to the War Department for the training of the occupational aides for hospital service in the World War. In common with the other instructors, I was doing my best to think up something worth while for this work.

Tin can toys seemed to be it, and they were. After completing the locomotive I made a steam roller, using a can for each roller and another one for a boiler, a flat tobacco can for a tank, a small flanged lid for a seat, a bot-

tle cap for the steam gage, and so on.

I made several other models and exhibited them to the authorities in charge of this work. They approved to such an extent that my entire time for more than two years was given over to teaching tin can toy making.

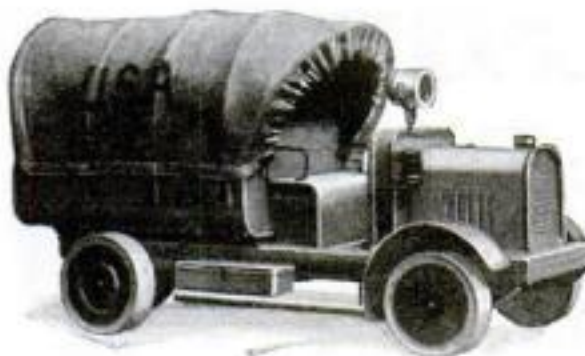
One of my pupils first took this work to France and I have some interesting pictures of tin can toys made within sound of the big guns by the wounded in a base hospital.

They not only made toys, but sink linings, drains, lanterns and candlesticks, Christmas tree ornaments, and many other things. This work soon spread to other hospitals both "over there" and here at home, where I am glad to say that it helped many a poor chap back to some interest in life.

William Campbell, my able assistant in teaching this work at college, was of great aid. He first saw the possibilities in tin can toy making for public school work. So the work spread to other schools; it was featured in the newspapers, the movies, and last, but not least, came a wonderful letter, from the British

Imperial War Museum, thanking me for my tin can toy models which had been sent over at their request with other American war toys. These toys are still there on exhibition. And it all began in a very small home workshop.

(Continued  
on page 92)



A realistic model of an Army motor truck made almost entirely from old cans



**30  
DAYS  
FREE  
TRIAL**

# 7 Tube Set Single Dial Radio



*The*  
**Metrodyne**

**ONLY ONE DIAL TO TUNE**

## Wonderful Offer Direct from the Factory!

A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial**. Test it under all conditions. Test it for distance, volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

**Retail Price**

**\$75**

**Completely Assembled**

**Big Discounts  
to Agents and Dealers**

### BIG PROFITS

#### TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

## Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nicked piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

An easy set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer**. You to be the judge.

## Mail COUPON Below!

**Let us send you proof of  
Metrodyne quality**

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am more than pleased with it. Got stations 2,000 miles away."

C. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that these one-dial sets are going to be excellent sellers. I had no trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Roy Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little tuning-knob which operates the electrically-lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer**.

### METRO ELECTRIC COMPANY

2161-71 N. California Ave., Dept. 159  
Chicago, Illinois

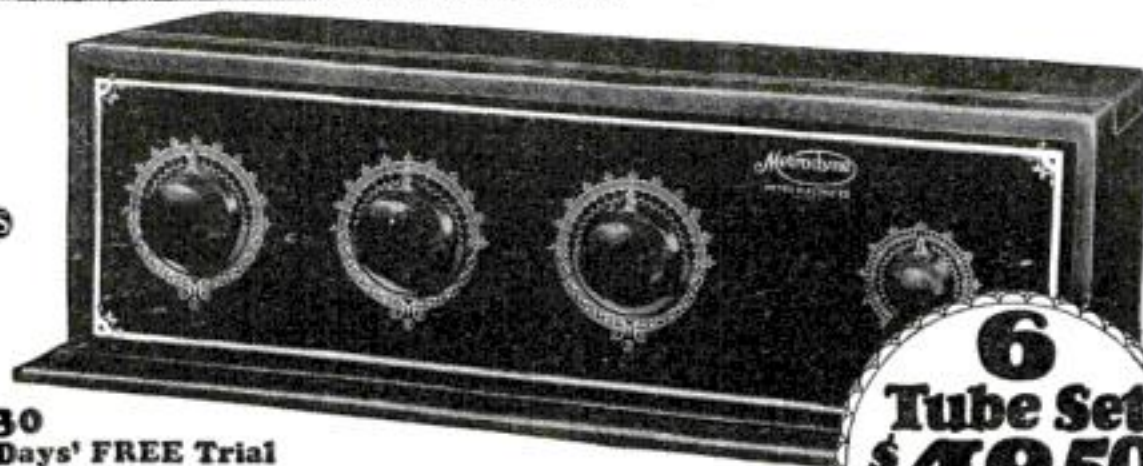
Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

Name \_\_\_\_\_

Address \_\_\_\_\_

If you are interested in AGENT'S proposition, place an "X" in the square ☐



**30  
Days' FREE Trial**

## Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne 6 tube long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer**, which gives you the opportunity of trying before buying.

## METRO ELECTRIC COMPANY

2161-71 N. California Ave. • Dept. 159 • Chicago, Illinois

**6  
Tube Set  
\$48.50**  
RETAIL PRICE  
Completely  
Assembled

**MAIL THIS  
COUPON**

or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer — **Save Money.**



# THOUSANDS OF RADIO SET OWNERS need these improvements

THE U. S. Navy, the Signal Corps, and 69 makers of leading standard sets use the variable resistance controls made by Central Radio Laboratories. These improved controls should be used on your set if you want the last word in quality for fine reception. Yet, owing to our huge output the cost is no more than for many inferior devices.

## Modernize Your Old Set with Centralab Modu-plug

Tone volume is, as you know, the one big improvement in this year's best sets. You can enjoy this improvement with your present receiver for only \$2.50. Modu-Plug is especially for that purpose. It provides full tone volume control from a whisper to maximum, simply by adjusting the small knob on the plug. Matches the speaker impedance to the set. Attaches instantly without tools. Standard type Modu-Plug replaces present speaker plug. Cord type fits sets not equipped with jacks. Either type, at dealer's, or mailed direct..... **\$2.50**

## Centralab Radiohm With "A" Battery Switch

Here is the variable resistance guaranteed always smooth, noiseless and permanent in adjustment. Tapered to control oscillation and volume, it also has a positive, quick acting "A" battery switch. One knob replaces two. Turning knob to right lights tubes, then increases volume. To left decreases volume, then cuts off batteries. Resistance is 0 to 500,000 ohms. You cannot imagine the great improvement until you try it. Adapted to all circuits. At dealer's, or mail direct... **\$2.30**

## Centralab RheostatS

Where your old design rheostat overloads, heats-up and quickly becomes noisy on new style tubes using increased current, Centralab Ribbon-type Rheostats will operate smoothly and permanently quiet. Insulated metal discs hold rigid a smooth flat resistance surface instead of wires, insuring even regulation and no dead spots. Every set using this rheostat is improved. 2 resistances for 5 to 10 tubes, at dealer's, or mail direct... **\$1.25**

SEND NO MONEY—If your dealer isn't supplied, order direct from us. Send no money. Simply pay postman on delivery, plus few cents postage. Install and test for 10 days. Then if you are not more than pleased and delighted with the wonderful results, return the goods to us and your money will be refunded. **10 DAYS' FREE TRIAL!**

Central Radio Laboratories

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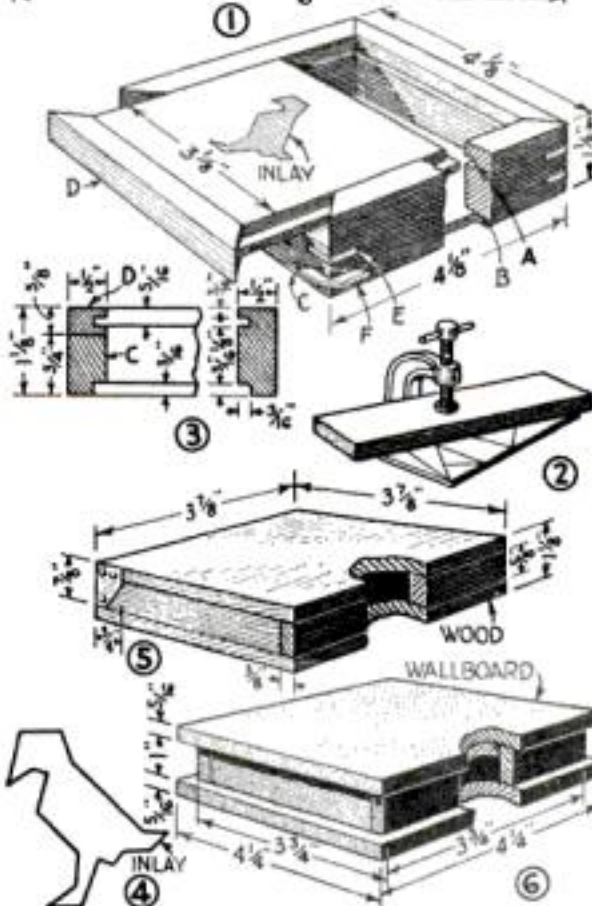
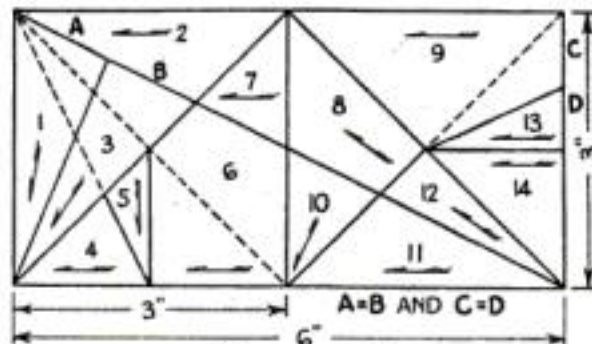
# Centralab

## The Home Workshop

### How to Dress Up the Puzzle of Archimedes

IF YOU have fallen under the fascinating spell of the Stomachion of Archimedes—the famous puzzle that drove men wild in ancient times, and, after a lapse of two thousand years, has been revived and made the subject of a prize contest announced last month in POPULAR SCIENCE MONTHLY—you certainly will want to play this curiously intriguing game with something better than a set of cardboard pieces.

A really fine set of the triangles with a case to preserve them will not take long to



A method of laying out the triangles; suggestions for making different types of cases

make. It will be something you can bring out for the amusement of your family and friends for years to come. Such a set, too, would be a splendid Christmas present because it would carry with it the appeal that always accompanies things that are handmade and cannot be purchased in the stores.

The puzzle preferably should be made of 3- or 5-ply wood or of a hard composition  $\frac{3}{16}$  in. thick of one of the types used for radio panels. Any wood, of course, can be used; pieces from a cigar box will serve, if no harder and finer wood is available. Even a set made (Continued on page 88)



## This is a Radio Christmas Make it Safe with a Belden Fused Radio Battery Cord

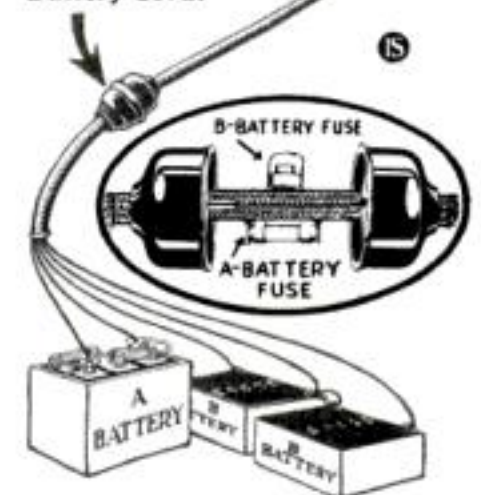


FOR a perfect Radio Christmas, protect the new tubes and batteries, and also avoid fire hazard from crossed wires by hooking up your set with a Belden Fused Radio Battery Cord.

The tiny A and B battery fuses, concealed in the little two-piece bakelite shell, can be easily inspected.

This handy cord also improves the appearance of the set and eliminates all loose wires.

Ask your dealer for a Belden Fused Battery Cord.



For maximum range and volume, ask your dealer for a Belden Aerial.

Belden Manufacturing Co.  
2304A S. Western Ave., Chicago, Ill.





Eveready's exclusive Layerbilt  
construction *makes this*  
*the most economical Eveready "B" battery*

IMPROVEMENT on top of improvement has been the history of Eveready Radio Batteries. Here, in the radically different Eveready Layerbilt, is the "B" battery which tops them all. The ability of this battery to give you unsurpassed service and economy is due to its unique internal design. Instead of the usual assembly of round cells, it is built of *flat* layers of current-producing materials pressed firmly together. This construction makes use of the spaces now wasted between the round-type cells and avoids the usual soldered wire connections. Eveready Layer-

bilt is every inch a battery. This exclusive Eveready Battery development packs more active chemicals in a given space and enables them to produce more current and give longer life.

Tuesday night means Eveready Hour—9 P. M., Eastern Standard Time, through the following stations:

WEAF—New York	WTAM—Cleveland
WJAR—Providence	WWJ—Detroit
WREI—Boston	WGN—Chicago
WTAG—Worcester	WOC—Davenport
WFI—Philadelphia	WCCO—Minneapolis
WGR—Buffalo	WCCO—St. Paul
WCAE—Pittsburgh	KSD—St. Louis
WEAL—Cincinnati	WRC—Washington

**EVEREADY**  
**Radio Batteries**  
*—they last longer*

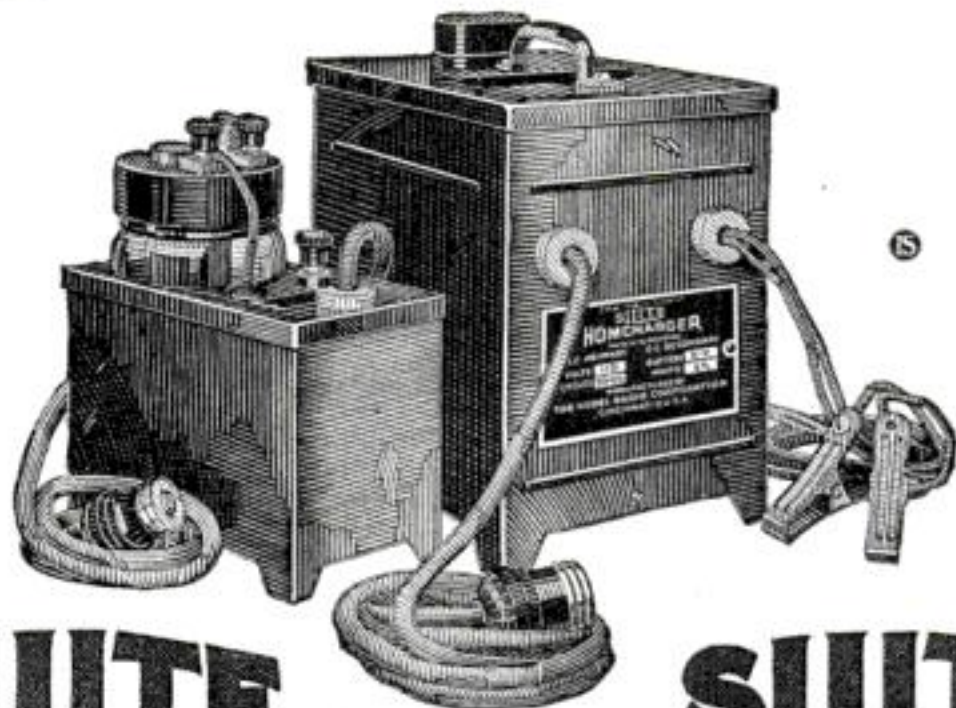
This HEAVY-DUTY EVEREADY LAYERBILT BATTERY gives twice the service of the smaller Light-Duty batteries and greatly reduces your "B" battery operating cost.

Use Eveready Layerbilts on any set, and get not only this extra service, but also—the maximum of "B" power operating economy—the utmost in "B" power dependability—D. C. (direct current) in its purest form, so necessary for pure tone quality. There is an Eveready dealer nearby.

Manufactured and guaranteed by  
**NATIONAL CARBON CO., Inc.**  
New York San Francisco  
Canadian National Carbon Co., Limited  
Toronto, Ontario



# A·B·C Light Socket Power



## SILITE

### TRICKLE CHARGER

Your battery troubles are over, at last. Now all radio power is in your light socket.

For continuous unfailing "A" current, connect either the Silite Homcharger or the Silite Trickle Charger to your present storage battery. Absolutely noiseless, without bulbs, moving parts, or adjustments, Silite Trickle Charger makes a power unit of your battery—keeps it always at top efficiency. Left permanently on charge, Silite Trickle converts light socket current into radio power and stores it in your battery ready for use at any time—you simply forget about battery charging forever. For exceptionally large sets where a high charging rate is necessary, the Silite Homcharger is recommended. Either model may be used while the set is operating.

**SILITE TRICKLE CHARGER**

.6 ampere charging rate.

Complete.....\$10.00

**SILITE HOMCHARGER**

2½-3 ampere charging rate.

Complete.....\$19.50

## Kodel A·B·Transifiers

Kodel A and B Transifiers actually deliver all A, B, and C current direct from the light socket—smooth, constant, never-failing power that operates your set always at its greatest efficiency. Vastly different from and superior to the ordinary power unit, Kodel Transifiers consume current only while the set is operating—maintenance cost is less than one-half cent for every hour you use your set. Any radio dealer can show you Silite Battery Chargers and Kodel Transifiers.



**MODEL 10 "A" TRANSIFIER**

Supplies 2, 4, or 6-volts "A" current direct from the light socket. For sets using up to 10 tubes.....\$42.50

**MODEL 10 "B" TRANSIFIER**

22½ to 150 volts "B" current; 4 to 10 volts "C" current for any size set. Operates power tubes.....\$42.50

**MODEL 61 "B" TRANSIFIER**

22½ to 90 volts noiseless "B" power for sets up to 6 tubes.....\$28.50

(Bulbs extra)

["Behind the Scenes in a Broadcasting Station" an interesting 24-page booklet, will be mailed free on request, together with literature describing Silite Chargers and Kodel Transifiers.]

**The Kodel Radio Corporation, 500 E. Pearl St., Cincinnati, O.**  
Owners and Operators of Broadcasting Station WKRC

Battery Chargers  
Power Units

# KODEL

Radio Receivers  
Loud Speakers

POWER SPECIALISTS SINCE 1912

## The Home Workshop

### Puzzle of Archimedes

(Continued from page 86)

of fiber wallboard or of cardboard taken from a heavy shipping carton can be made attractive if well finished.

The first thing to do is to lay out the puzzle as accurately as possible. How to do this was explained last month, and the diagram is repeated in Fig. 1.

If cardboard or wallboard is used, it can be cut with a sharp knife; if wood or harder materials are used, the parts will have to be cut with a fine saw; and some allowance, therefore, will be necessary for the width of the saw kerf.

**P**ERHAPS the most convenient size to make the puzzle is on the basis of two 3-in. squares, as in Fig. 1, provided the material is not more than ¼ in. thick. With ⅜ in. thick material it is better to use 4-in. squares, but such a set is a trifle cumbersome.

If plywood or radio panel material is selected, draw a rectangle 3⅝ by 6⅝ in. and lay out the parts within it so as to allow for the saw kerfs and for finishing the edges. A straightedge clamped to the stock, as in Fig. 2, is an aid in sawing accurately to the line.

In finishing the edges of the parts with file and sandpaper, do not trust your eye entirely, but draw another diagram on paper within a rectangle 3 by 6 in. and use it to test each piece.

A slightly different procedure is necessary when ordinary wood is being handled. Draw the diagram the finished size on heavy paper, cut out the pieces, and then mark the wood so that the grain of each piece will run as indicated by the arrows in Fig. 1.

If made of wood, the game can be finished with one coat of stain, two coats of shellac rubbed with No. 00 sandpaper, and, finally, a coat or two of furniture wax. An alternative method is to color the pieces with two coats of enamel or brushing lacquer. Compositions such as hard rubber will need no finish except on the edges; these can be shellacked, lacquered, or varnished. The parts then can be numbered, if desired.

**T**HE game is not complete, however, without a suitable case. No doubt the Greeks paid much attention to the container because the game was often known as the Loculus of Archimedes, and loculus referred to the case or cell in which the parts were packed.

For ¼ in. thick pieces based on a 3-in. square, the box should be 3⅝ in. square inside and a trifle deeper than two thicknesses of the material used.

A neat case and one that requires fairly accurate hand work or the use of a fine cutting circular saw is that shown in Fig. 3. Thinner stock than that indicated may be used and the dimensions modified accordingly, but the lighter the box is made, the more skill and delicacy of workmanship are required.

Prepare a piece of the selected wood ½ by 1⅝ by 22 in. long, cutting a groove ⅜ in. wide by ⅜ in. (Continued on page 90)



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### The Home Workshop

#### Puzzle of Archimedes

(Continued from 88)

deep, as at A, and a rabbet  $\frac{3}{16}$  by  $\frac{3}{16}$  in., as at B. Cut five pieces with mitered ends so as to be  $3\frac{1}{8}$  in. long on the inside. Cut the groove from one of these to leave piece C and from another, to leave piece D. Glue piece C and three others together. When the glue has set, make two narrow saw cuts at each corner, as at E, into which splines may be glued. The splines (F) are thin strips of wood with the grain running lengthwise. Plane the projecting edges of the splines flush when the glue has hardened.

Make the top of  $\frac{3}{16}$ -in. material. Rabbet the edges to fit the grooves A on all sides and glue one end in the rabbet of piece D. Make the bottom of  $\frac{3}{16}$ -in. stock to fit the rabbet B and fasten with small brads.

**A** BOX as well made as this deserves the finest possible finish. One way of ornamenting the cover is to inlay it with a suitable design, such as suggested in Fig. 4, or one of the solutions to the puzzle illustrated last month. Cut this from a piece of veneer or from very thin wood, lay it upon the top and mark around it accurately with a sharp knife. Make the knife marks nearly as deep as the thickness of the inlay, and then remove the wood between the lines with a knife, flat gouge or chisel. Have the recess uniform in depth and a trifle shallow rather than too deep. Glue the design in place and when the glue is hard give it a coat of shellac. The next day, sandpaper the design flush with the surface of the top. The box then may be finished with shellac and wax, lacquer, or varnish.

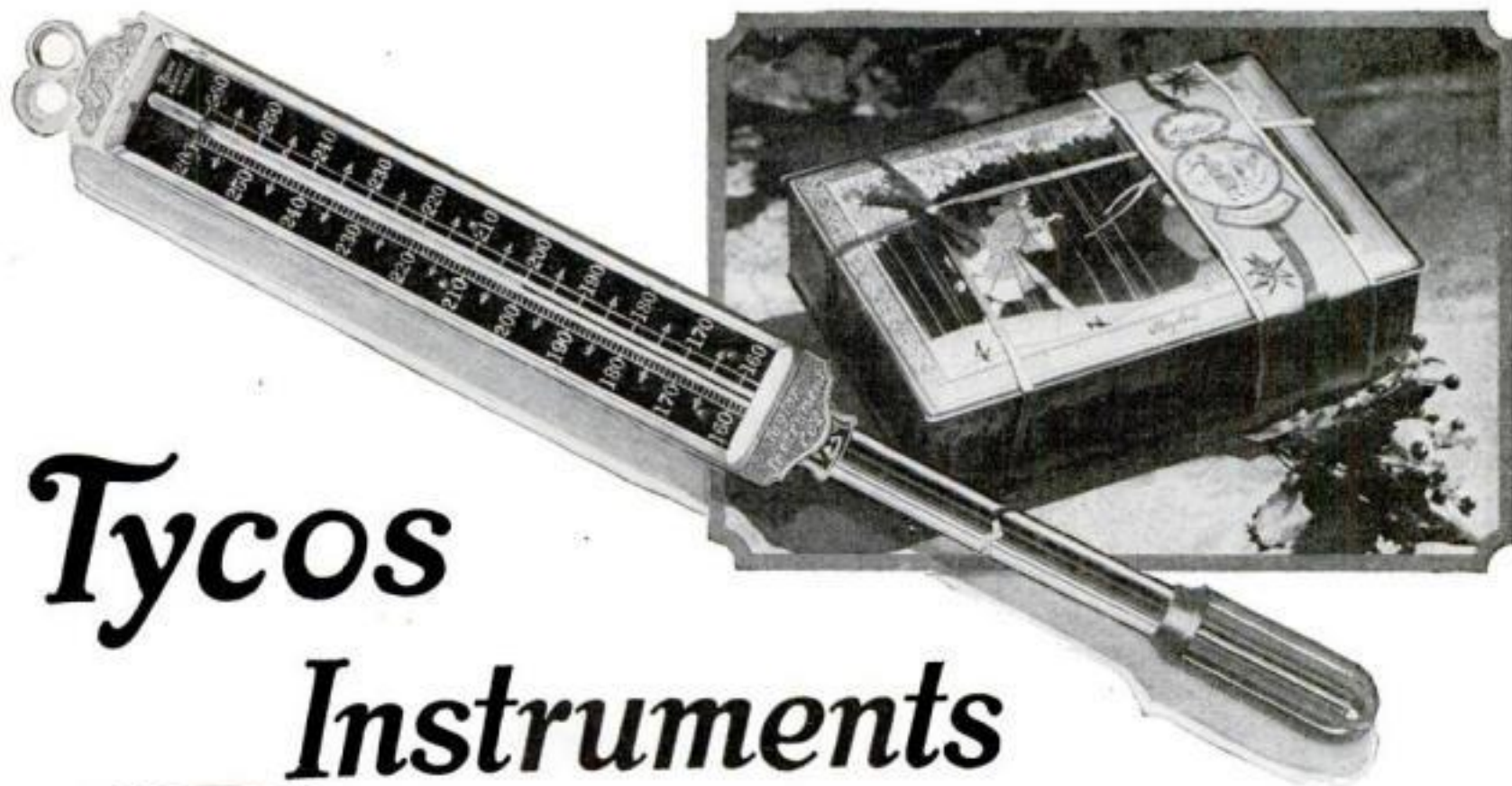
A case of much simpler construction is shown in Fig. 5. Cut two ends  $\frac{3}{8}$  by  $\frac{3}{8}$  by  $3\frac{1}{8}$  in., two sides  $\frac{3}{8}$  by  $\frac{3}{8}$  by  $3\frac{1}{8}$  in. and two pieces for the top and bottom  $\frac{1}{4}$  by  $3\frac{1}{8}$  by  $3\frac{1}{8}$  in. Nail the corners with 1-in. No. 18 brads. Then make two hinge pieces of sheet brass or tin and fasten with small brass nails as shown.

**T**HE top of this box can be left plain or decorated with a design like Fig. 4 drawn in black drawing ink after the wood has been given a thin coat of shellac. In that case, spray another coat of very thin shellac on with an artist's fixative blower, a perfume atomizer, or a small garden spray, so that the design will not be blurred. The box then may be finished with another coat of shellac and two coats of furniture wax.

Fig. 6 suggests a method of making a box of fiber wallboard. Cut two ends 1 by  $3\frac{1}{8}$  in., two sides 1 by  $3\frac{1}{8}$  in., a bottom  $4\frac{1}{4}$  in. square, and two pieces for the top, one  $4\frac{1}{4}$  in. square, the other  $3\frac{1}{8}$  in. square. Glue the sides and ends at the corners and when the glue has set, fasten this rim to the bottom. Also glue the two top pieces together. This top requires no hinges.

The wallboard box should be finished with colored enamel or lacquer. It can be ornamented with a design cut from thin colored paper, pasted smoothly upon the top, and given a protective coating of clear varnish or lacquer.





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### The Home Workshop

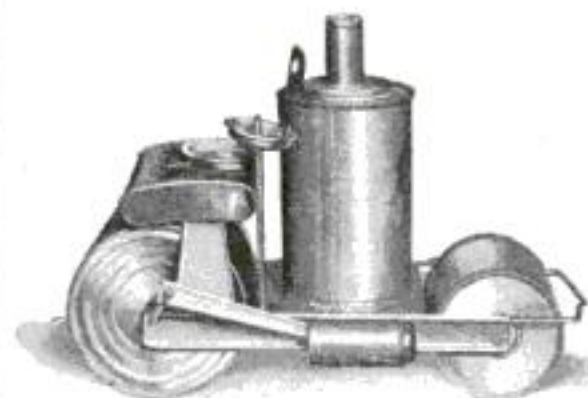
#### Tin Can Toy Making

(Continued from page 84)

Of all the tin can toys, the steam roller is one of the most typical models. This was a great favorite with the wounded soldiers.

The illustration on page 94 shows how the different cans are combined to make this toy. The boiler is soldered open end down to the crosspiece between two strips like channel-iron. These make the sides of the frame. These strips and the crosspiece are made from flat strips cut from tin taken from cans, flattened out and folded to shape.

The front roller is made from a condensed or evaporated milk can, as these cans are usually emptied by punching two holes in the top. After the can is emptied it should be soaked in hot water and all the water emptied out before soldering up the holes. A hole is punched in the center of the ends of the can and a piece of stiff wire soldered in for an axle. Between each end of the can and the



A soldering iron and tin snips are the principal tools needed for making toys like this.

frame is a sort of washer made of a narrow strip of tin rolled around the axle as shown.

The rear roller, which is larger in diameter than the front, is made from a tomato can, or rather two tomato cans of the same size. As the tomato can is longer than the condensed milk can, it must be cut down. A line is scribed around it at the proper height and tinner's snips are used to cut away the extra tin. Hold the open end of the can toward you and cut from right to left.

The bottom is next cut from another tomato can of the same size in such a way that about  $\frac{3}{8}$  in. is left intact above and around the bottom. This may be done with a sharp can opener, cutting around the sides of the can, or by cutting spirally down from the top with the snips, again from right to left.

The ring of tin left above the bottom of the can is slit to the bottom of the can with cuts about  $\frac{1}{4}$  in. apart. The can that is to be used as a roller is then placed over a piece of pipe or similar anvil and the cut end enlarged slightly by hammering it so that the bottom of the other can will fit in it after the notched pieces have been hammered in slightly toward the center of the can. When the pieces fit nicely together, they may be soldered in place. Rollers and wheels of many diameters and

(Continued on page 94)



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5. How do we know that the earth is slowly shrinking? .....
6. What is an electric current? .....
7. How was petroleum formed? .....
8. Do electrons really move through wire when an electric current is flowing through it? .....
9. What physical changes in your body are produced by fear? .....
10. How do muscles exert power? .....
11. What are X-rays? .....
12. Can we see atoms with a microscope? .....
13. Why does heat expand things and cold contract them? .....
14. Why does the moon appear to change its shape from time to time? .....
15. What is the brain made of? .....
16. Why is it possible that the inside of the earth is growing hotter instead of colder? .....
17. Why is frost more likely on a clear night than on a cloudy one? .....
18. Does thinking use up the thinker's energy? .....
19. Which travels faster, electricity or light? .....
20. What simple test will distinguish wool from cotton? .....
21. What makes the noise of thunder? .....
22. Why would men ultimately suffocate if all the green plants were killed? .....
23. Does the boiling of water remove the impurities in it? .....
24. How do the living cells of the body get the energy with which to do their work? .....
25. How is the speed of light measured? .....

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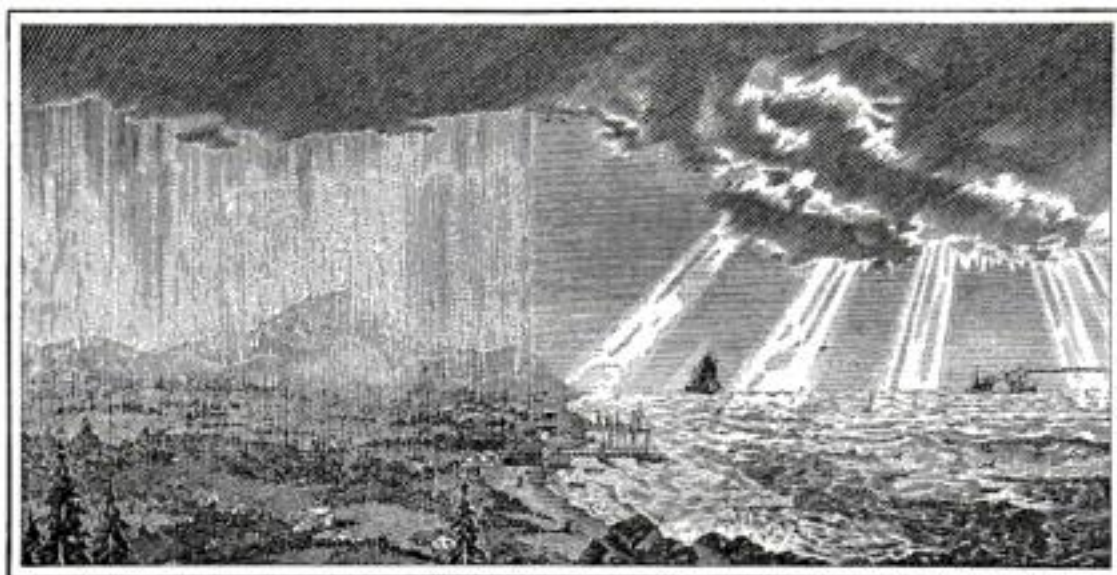
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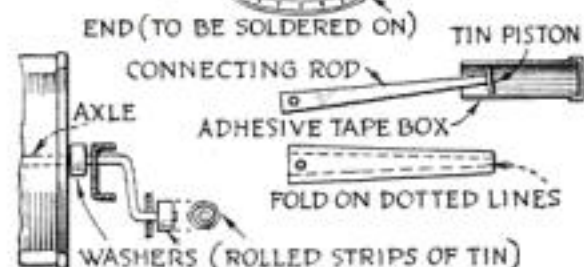
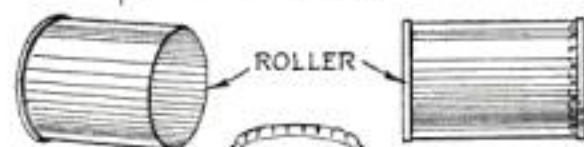
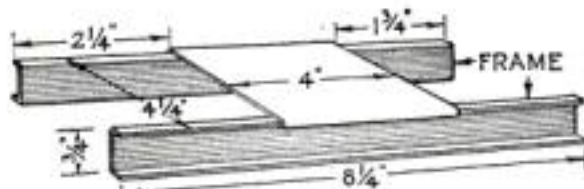
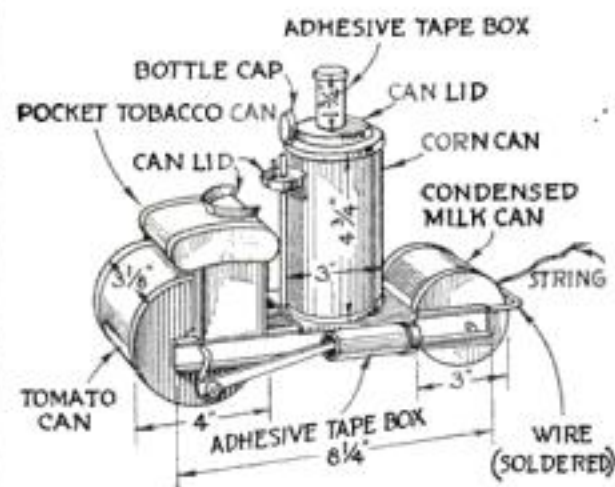
## The Home Workshop

### Tin Can Toy Making

(Continued from page 92)

widths may be made from cans in this way.

Another method of making rollers and wheels is to use cans which have soldered caps on each end, such as condensed milk cans. These caps may be melted off in an open flame. A slight knock with an edged tool will remove them when the solder is melted. Another can of the same kind is cut down to the proper width and the piece melted off the first can is soldered in place. It will be found that the end melted off the first can will have to



How the steam roller is assembled; details of frame, rollers, and piston mechanism

be enlarged slightly on an anvil before it will fit on the end of the second can.

The tank to which the seat is mounted is a pocket tobacco can. This is soldered to the two upright pieces, which are, in turn, soldered to the frame.

Strips of tin may be folded into angle or channel-like forms in several ways. The simplest is, of course, to use a regular folder such as the tinner uses. The next best is a wooden roofing folder, but this is not found in the usual tinker's shop.

Two pieces of hard wood about 3/4 in. thick, 2 in. wide and 12 in. long may be made into a simple folder. These are placed in the vise, parallel with the jaws. The pieces should be finished off in such a way that the upper and outside edges of them are chamfered off sharply at more than 45 degrees. The strip of tin to be folded is placed (Continued on page 95)



## The Home Workshop

### Tin Can Toy Making

(Continued from page 94)

between these wooden jaws, the vise is screwed up firmly, and then a mallet is used to fold over the tin.

The cylinder on the side of the steam roller is a tin adhesive tape box, or a piece of tin rolled into cylindrical form with a bottle cap soldered over one end for a cylinder cover. The connecting rod is a folded strip of tin, one end of which is soldered to a disk of tin, for a piston. This disk fits loosely into the cylinder. The crank for the rear roller is a piece of stiff wire bent to shape. If galvanized wire is used for the front roller axle and the crank axle of the rear roller, you will find pure muriatic acid best for a soldering flux; soldering paste or "killed acid" is the best flux for tin.

**T**HE steam gage may be made from a bottle cap soldered to the top of the boiler; tinned rivets may be soldered to the side of the boiler for trycocks; a small .22 caliber shell for a whistle; a small can lid soldered to a piece of wire makes a steering wheel.

When making the tin toys you will find that an ice pick or marking awl is an excellent punch for small holes.

Remember to have all metal to be soldered bright and clean. Your soldering copper must be hot enough to melt the solder easily and quickly, but if it is too hot the tinning at the point will be oxidized or burnt away. The copper then will be useless until it has been filed bright and retinned, by heating it, covering it with flux, and rubbing it in melted solder on a well fluxed piece of tin.

Remember, too, that the soldering copper must be left in place long enough to heat the joint to be soldered to the melting point of the solder.

After the war we determined to pull up stakes and move to the real country, and make toys. So we came to the shop in which I am at present at work. This is located on a hillside, back of the house, on the site of what was once a tremendous stone pile.

**M**Y FATHER and I built a track over 250 ft. long, using chestnut two-by-fours for the rails. Later on these "rails" served as framing for the shop. A car was made with a set of wheels from the junk yard. When loaded, this ran by gravity down the track, back of the house, around a curve, over a bridge, and so on out to the new stone pile. The wooden rails around the curve were lined with strap iron. An incline at the end of the track stopped the car. We loaded and sent down 396 half-ton loads before we could begin to build the new shop.

At last all was ready to start building and my boy Mike drove the first spike in the timber sills.

Local carpenters finished this frame and put on the roof. Father and I put on the siding, laid the floors, put in the windows, built the stone forge, and at length completed the shop as it is.

The main floor is divided into three parts such as my (Continued on page 96)

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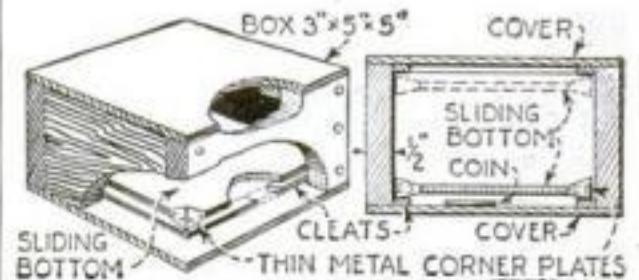
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## The Home Workshop

### This Magic Box Causes Coins to Disappear

COINS, rings or any small articles less than 1/4 in. thick can be made to disappear and appear again mysteriously in the simply constructed box illustrated. This box will astonish an audience of young children.

The performer places the box on a table, around which the children are allowed to stand, and, opening it, asks someone to put a coin or ring into it. He



The box has two covers and a freely-sliding false bottom for concealing small objects

replaces the cover and goes through what seem to be meaningless motions.

When the box is replaced on the table, it is found to be empty. That is because it has been turned upside down and a duplicate cover opened. The object is hidden by a thin, sliding false bottom, guided by metal corner plates as shown. The object is recovered by reversing the operation.

The box can be made of scraps of wood and had best be painted gray inside and blue outside.—DONALD W. CLARK.

### Tin Can Toy Making

(Continued from page 95)

previous shop experience had taught me would be convenient, particularly during the cold winters. In the main shop are located the forge, blower and anvil, gasoline engine, engine and speed lathes, circular saws (large and small), bandsaw, grindstone, post drill, bench drill, grinding and polishing head, and jointer, all power driven. There are several dynamos of different voltages.

Back of the forge is another small shop, complete in itself; in this are the lighter tools for bench work, soldering, brazing and so on, and a small speed lathe and a grinding and polishing head. One of the line shafts runs into this shop.

The other room on the first floor is also complete in itself as to lighting and heating. In this room are many of my books and considerable radio equipment.

Into this last shop I have tried to build everything I have learned about shops. Much of the equipment I make myself as I find I need it. The junk yard is a happy hunting ground—shafting, pulleys, belting, gears, and many other things I find there, but I never buy junk unless with a definite idea of using it.

And so, to conclude, I find that my shop has done practically everything for me, as I trust it will do for years to come.

*This is the concluding article in Mr. Thatcher's series on his adventures in toolcraft, which began in the September issue.*



## The Home Workshop

### Brushing Lacquer

(Continued from page 68)

and that next. This grip enables one to back up the paper with his hand, which is an ideal pad. By dipping the paper into the soap solution, then into the pumice-whiting mixture, and rubbing it on the lacquer, we were able to cut down the surface faster than we had expected.

We were very careful to rub only in straight lines parallel to the floor. As often as the paper became glazed, we discarded it for a fresh piece.

**A**FTER Dan had made a good start, I followed him with a hard,  $\frac{1}{2}$  in. thick rubbing felt dipped into the pumice-whiting mixture. I used plenty of soap solution to keep the surface wet.

We cut each section completely before starting on the next. As soon as the work had been rubbed clean, I washed it off with water and a sponge, then chamoised it dry so that I could examine the surface for parts not rubbed enough.

Our next process was to make a mixture of vinegar, one part; light machine oil, one part; rottenstone, one part; and water, three parts. With an old cotton flannel cloth folded into a square pad, we polished the surfaces to a brilliant gloss. Last of all, we used a commercial polish made especially for lacquer.

When we were through the job was like a mirror, for I could see the beads of perspiration on my head just as plain as day. But it was worth it.

**"N**OW that I have the hang of it," Dan commented, "it seems to me that it isn't a great deal tougher rubbing than on varnish work. Anyhow, it certainly pays to rub out the body like this. I really can't say that I like the eggshell finish; it looks like a lazy man's job."

"That's the way it appeals to me too, Dan. Do you know, now that we have gone this far with the job, I believe I will take the car over to Jones and Haddock and have them do a little striping work."

And so about two o'clock that afternoon we drove over to the auto shop and had the stripes run on the body. Then I let Dan take the wheel.

"Just leave me at the laboratory," I said, "and you can surprise Mother with a ride for the rest of the day."

And Dan drove off up the street as proud as a peacock.

*This is the second of two articles on refinishing an automobile with brushing lacquer. The preparatory steps were described in detail last month. It should be noted that in buying brushing lacquer for use on an automobile, a brand should be obtained that is recommended by the manufacturer for this work. Not all lacquers, any more than all enamels, are intended for such an exacting service. Furthermore, not all old finishes will stand the solvent action of the thinners used in lacquers, so that the car owner must use his own judgment and make a preliminary test on some inconspicuous part of the car, if he thinks it necessary.*



## "Gee, Dad, won't Mother be surprised!"

**W**ITH the Christmas holidays drawing near, what gift is more useful, more appreciated, than a gate leg table made with the help of your youngster — and good tools?

To shape the legs and cross pieces — to round off sharp corners and smooth rough surfaces — use a **NICHOLSON Cabinet File** (made especially for this purpose).

There are many **NICHOLSON** Files to do the many jobs around the house. Let your local hardware dealer help you select the right files.



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Hundreds of plants are replacing their novelty saws with the new Simonds Planer Saws because the Planer Saw leaves a smooth cut at a faster hand feed than is obtainable with novelty saws.

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**YOU** install power tubes in your set to get purer tones and to eliminate distortion.

Concertones have a large enough core and winding to receive the lowest notes from the tubes and to reproduce them without distortion or "blasting." Heavily insulated.

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You ought to have this handy Parks in your shop. It is a compact, complete machine designed just like a big production outfit at one-fifth the cost. Includes 8-inch circular rip and cross cut saw with polished cast-steel saw table, 16-inch band saw with tilting table for bevel-sawing, 6-inch jointer, and motor operating from any light socket. Just plug in and go to work! Fits in a corner of your basement. Does any kind of cabinet and joinery work. Add lathe, shaper and other attachments any time at small cost. For the man who does "odd jobs" in his off time this Parks is a big money maker. Turn out as much as a four-man shop working by yourself.

Write for circular and Parks complete catalog of handy woodworking machinery

**The Parks Ball Bearing Machine Co.**  
 1547 Knowlton Street  
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## The Home Workshop

### Toy Birds and Animals

(Continued from page 67)



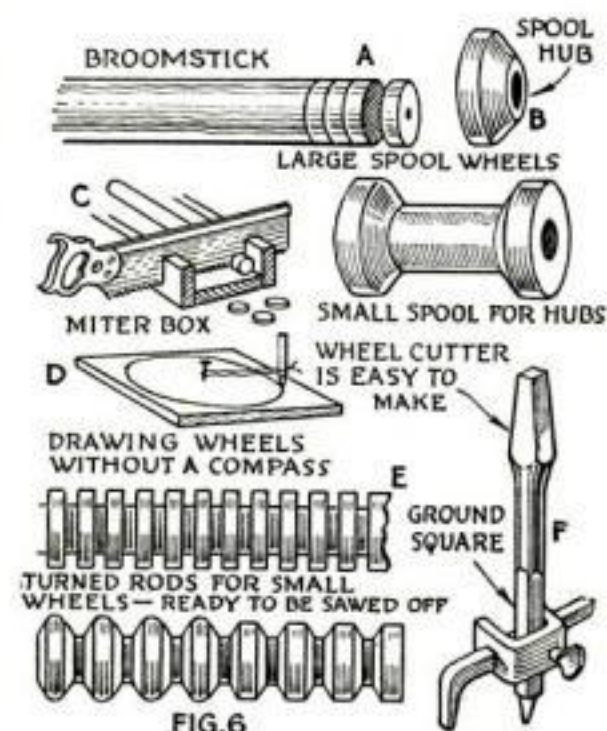
More toys from Mr. Hughes' collection. He is a specialist in their construction

corresponding proportions. There is enough variety to keep you busy for weeks.

If you have this blueprint, you can transfer whatever designs you wish on the wood by means of typewriter carbon paper. Another method, which is quicker if you intend to make a quantity of the toys or have the children help with the work, is to paste the various designs on bristol board or tough, thin cardboard and then cut them out so that they can be used as templates to trace around.

Attention is called to the character of most of these forms, with their simple lines and large feet. If these forms had not been changed in this way the smaller parts would split when cut from wood. Tails in most cases should be removed entirely when sawing and leather or twine substituted.

It will be noticed also that all of the illustrations of birds in Fig. 9 show only one leg; and of the animals, only the



Broomsticks and spools as used for wheels; methods of turning wheels; a wheel cutter

cow has all four legs. This simplification, if the toys are cut from one piece of wood, makes the work easier and the result more satisfactory from the standpoint of durability.

You are not limited to these designs. Many pictures of animals may be found in books, magazines and newspapers, and these may be (Continued on page 99)



## The Home Workshop

### Toy Birds and Animals

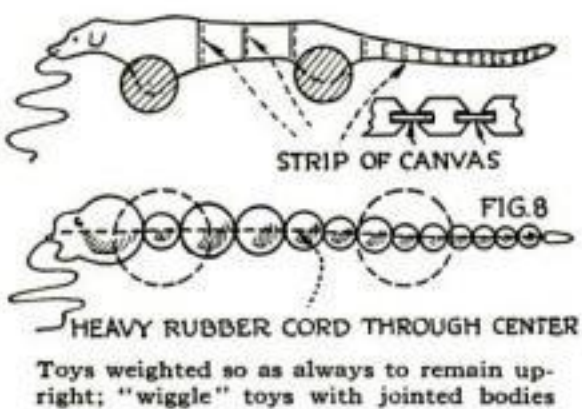
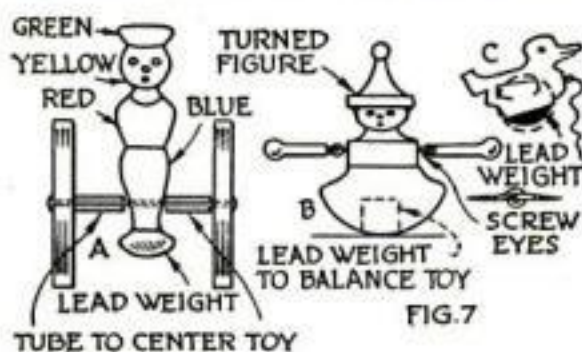
(Continued from page 98)

made adaptable to wooden toys if simplified in the light of the designs shown.

If a toy is to be cut from plain boards, the grain of the wood must be considered and made to run in the direction best serving to strengthen the weaker parts. The different drawings in Fig. 9 have arrows to indicate the direction in which the grain of the wood should run. If three-ply wood is used, the grain usually can be ignored.

What thickness of wood to select depends upon the size of the toy, the form of construction, and, to a lesser degree, upon the kind of wood. Three-ply parts can be thinner than those of solid wood.

An elephant made the size shown on Blueprint No. 56 should be  $\frac{3}{4}$  in. thick if a



single piece, and  $\frac{5}{16}$  or  $\frac{3}{8}$  in. thick if in three parts. The cow, cat and donkey should be  $\frac{1}{2}$  in. thick if single and  $\frac{5}{16}$  in. if in three pieces. The birds and fowl may all be  $\frac{1}{2}$  in. thick.

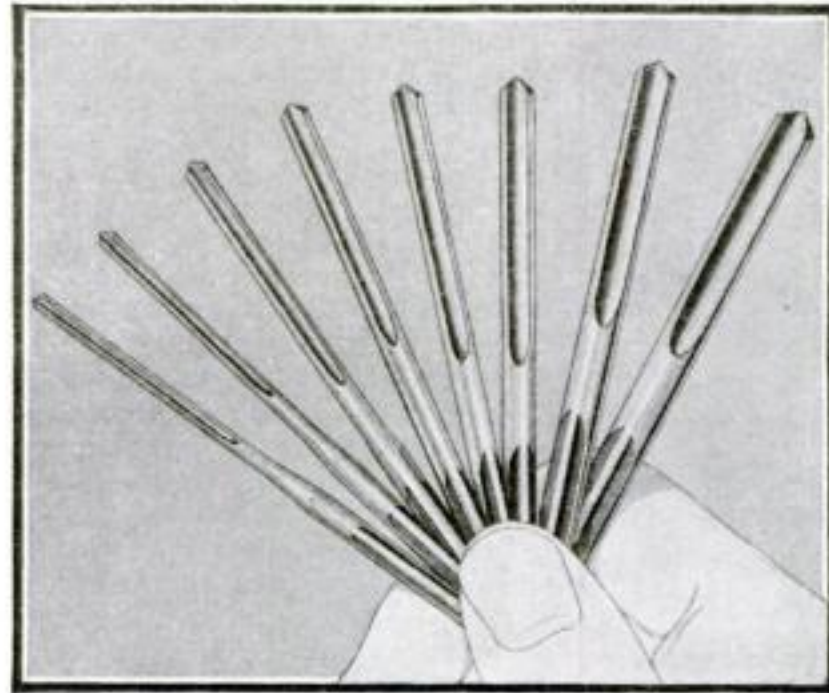
The duck can be made into an especially attractive toy if cut from  $\frac{3}{4}$  in. thick stock with the head separate and loosely doweled in place so that it will turn. The puppy looks best if  $\frac{3}{4}$  in. thick.

After the toy has been cut to shape and smoothed with a bit of sandpaper, the kind and style of base should be carefully considered, because the base has much to do with the general attractiveness of the finished article. Each individual toy seems to call for a special type of base and the form should be studied with this in mind. Some toys look best on a round base, others need a square base.

If wheels are to be used on the base, the size of the wheels should be considered in relation to the width of the base. As a general rule, the width of the base should equal about one half the height of the toy.

In Fig. 3 are shown a number of bases. A and B are removable. In the case of smaller animals for a Noah's Ark and other col- (Continued on page 100)

# To bore clean holes quickly -- easily without splitting or cracking



Here are the eight different size drill points included with Mr. Punch

## Use Mr. Punch the Goodell-Pratt Automatic Drill

**T**HIS automatic drill makes holes of any diameter from  $\frac{1}{16}$  to  $\frac{11}{64}$  of an inch—and does it quickly—and clean as a whistle.

You push—Mr. Punch twists. No skill is needed to do the job right. No cracking, or splitting, or splintering. Hard wood, soft wood, plaster—are all alike to Mr. Punch.

A hollow space in the handle is divided into 8 compartments, each to hold a drill point of the size marked on it.

To get the drill you want, just turn the cap so that the top hole is opposite the compartment the desired drill is in. The point is released through the top hole.

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Catalog No. 16 pictures and describes each of the famous Good Tools made by Goodell-Pratt. This book is interesting and valuable to every one who works with tools. It's FREE. Write for a copy now.



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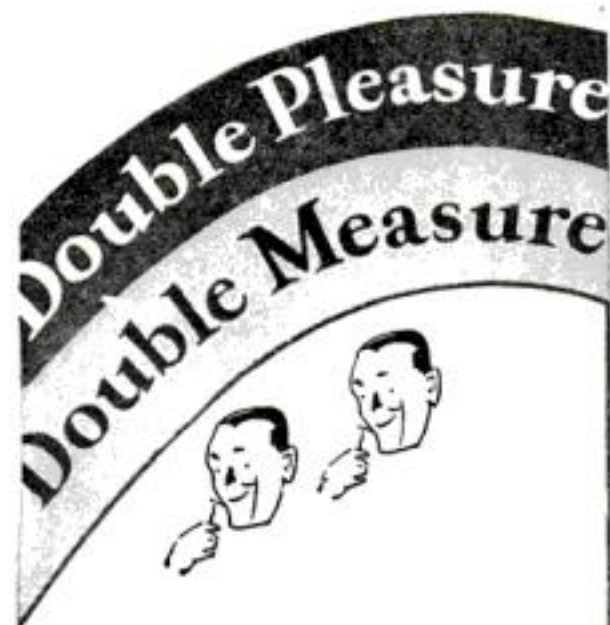
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## 1500 GOOD TOOLS





## 100% Perfect Blades to the Package

**W**E don't do things by halves! We're not satisfied just to make Gem Double Life Blades double-keen! We make them double-thick to hold their keenness! We double-reinforce them so they're double-rigid!

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GEM SAFETY RAZOR CORPORATION  
Brooklyn, N. Y.

# GEM

## Double Life BLADES



## The Home Workshop

### Toy Birds and Animals

(Continued from page 99)

lective groups, a small cardboard disk glued to the foot is sufficient.

Wooden animals may be made up in a single piece (A, Fig. 1), or in three sections nailed together, as at B. For birds and fowls either a base is used or wheels with a counterbalance (Fig. 7).

Small wheels may be made from a broomstick or curtain rod as suggested at A and C in Fig. 6. A stop block placed in the miter box helps to keep the thickness uniform. Two styles of small turned wheels are shown at E.

In finding the center and drilling the holes in all of the wheels, care must be observed, or they will be one-sided. A jig with a fixed center can be devised to aid in drilling these centers.

For drawing the larger wheels use a compass or pair of dividers or the method shown in sketch D, Fig. 6.

If a washer cutter, such as used by steam fitters for cutting gaskets, is to be had, a very good set of wheels may be cut out, provided the wood does not exceed  $\frac{1}{2}$  in. in thickness. A satisfactory wheel or washer cutter may, indeed, be improvised as shown at F, Fig. 6. The shank is made from an old auger bit.

The larger wheels may be varied in appearance by using different hubs with a plain wheel, as shown at B, Fig. 4. Tin roofing washers used for hubs give neat-looking wheels. Again, several holes may be bored as shown at C, Fig. 4. In the same group E is a painted design that looks well on circus wagons, carts, and the like. At D are shown some examples of turned wheels of various designs.

Spindles or bearings for the wheels may



"Cute" may justly be used to describe some of these brilliant and charming little toys

be of several different types, as in Fig. 5.

Among the newer wooden toys on the market are to be found some very attractive little wheel toys that are weighted so they always remain in an upright position. Figure 7 (A, B, and C) suggests how several of these little novelties are made. Beads sometimes may be used as spacers instead of tubes as at A.

Some of the semi-mechanical animal toys in the toy shops have one end hinged so that the other can be moved up and down by an eccentric in one of the axles. The principle of the eccentric is indicated at G, Fig. 3.

The jointed toy made in several sections and arranged (Continued on page 101)

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**CROWN FUEL SAVER**  
*mixes* **RED HOT OXYGEN**  
WITH GASES OVER  
FURNACE FIRE BED.  
**SAVES 20% of FUEL**

You can have the cosiest, warmest home this winter by simply attaching the Crown Fuel Saver to the feed door of your heating plant.

By doing so you will save at least 20% of the coal you usually pay for—get decidedly more heat from the coal you burn—reduce the number of firings—and keep every room livable and comfortable.

### The Crown pays for itself

in comfort alone—in healthful heat that conquers cold and dampness. The Crown pays for itself in actual money. For, we absolutely guarantee the Crown to save at least 20% of the coal you ordinarily use, or we will refund its purchase price without argument.

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## The Home Workshop

### Toy Birds and Animals

(Continued from page 100)

to wiggle when it is drawn along is always interesting to the children and quite simple in construction, as shown in Fig. 8.

The main points in successful toy making are simple lines, solid construction, and clear, bright colors.

For most of the smaller toys the gloss paints, carriage or auto enamels and



Full size templates of these toys are contained in Blueprint No. 56. See page 102

colored lacquers have been found most satisfactory. For simple work the three primary colors, bright red, clear, brilliant blue, and yellow, with the addition of black and white, are all that are needed. These may be combined to form all the others. The work should be given a priming coat first, and when this is dry, the colors applied in the order of the lightest first. As a rule it is best to let each color dry before applying the others. Eyes and small lines may be added with the point of a nail or a toothpick, if a small pencil brush is not at hand.

For additional suggestions about painting toys, see page 80.



Saal Ec-centric Cone

—based on the principle of the melodious harp with its short and long strings, the short and long sides of the Ec-centric Cone provide vibrating area for both high and low notes. Completely eliminating drum or barrel tone. Operates equally well with or without power amplifier. Price, \$25. Junior model, \$15. All prices slightly higher west of the Rockies.



Saal Horn No. 5

—Later model of the famous "Saal Soft Speaker." Bell of genuine Bakelite, goose neck of cast aluminum. Nothing to warp crack or deteriorate. No metallic ring. Guaranteed not to blast or chatter. As used by radio engineers in laboratory tests. Price, \$22.50.



Saal Pedestal

—Can be readily moved to any desired room or position. Tones emerge from both front and back of gold cloth grille, hence non-directional. Top is level with your ear when you are seated tuning in. Rich American walnut finish. Price, \$38.

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The SAAL Ec-centric Cone is the year's outstanding development in the cone field. Its short and long sides are scientifically balanced for sound reproduction. For the first time a cone speaker of only 20 inches diameter reproduces the slightest whispers of the

human voice.

For those who prefer the type of speaker used by radio engineers in experimental and test work, the SAAL Horn is unsurpassed. Its goose neck of non-vibrant aluminum is based on the scientific musical design of the mellow saxophone.

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All SAAL Speakers have the same standard of complete tonal reproduction.

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When it comes to making repairs TRIMO Pipe Wrench is unsurpassed in design, efficiency, strength and handiness. Buy several sizes to meet all emergencies. Remember—this is THE Pipe Wrench that has a replaceable INSERT JAW in the handle—that its pressed steel frame WILL NOT BREAK and the NUT GUARDS on the TRIMO which keep this wrench adjusted in close quarters guarantee quick, continuous work. While the teeth of the TRIMO grip firmly, they will not lock on the pipe, but release readily. Eight steel handle sizes from 6 to 48 ins.; four wood handle sizes, 6, 8, 10 and 14 ins.

### TRIMO Monkey Wrench

The Trimo Monkey Wrench is simple in construction, has only three main parts, is practically indestructible, and its strength has been proved by actual test. Seven standard sizes, 6 to 21 inches. Fully guaranteed.

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ROXBURY, MASS. 313

## The Home Workshop

### Blueprints to Aid You in Making Toys

YOU will agree, no doubt, that toy making is the most fascinating work done in the average home workshop. Three of our blueprints are devoted to toys. Details of an electric train, a kiddie broncho, which is a toy for small children to ride, and a 20 by 36 by 36 in. doll's house are given in No. 14, listed below. Drawings for a toy tea cart and game table, a toy garage, and a bunny wheelbarrow, are contained in No. 29, and for many fret-sawed toys in No. 56 (see page 67).

### Complete List of Blueprints

ANY ONE of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The corresponding back issue of the magazine, in which the project was described in detail, can be had for 25 cents additional so long as copies are available. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

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46.	Galleon Model—Hull	May, '26	25c
47.	Galleon Model—Details	June, '26	25c
48.	Sailing Yacht Model	July, '26	25c
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Send me the Colonial Tilt Top Table, with free materials and instructions for decorating. I will give the postman \$9.75 plus postage which you will refund at once if I return the table and materials within 5 days. Send me colors of enamel checked. ☐ Black ☐ White ☐ Chinese Red ☐ French Grey ☐ Lettuce Green ☐ Grass Green ☐ Dark Blue ☐ Light Blue ☐ Orange ☐ Ivory.

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## The Home Workshop

### The Trick of Making a Fuse Chart

By GEORGE A. WILLOUGHBY

Supervisor of Electric Work, Arthur Hill Trade School, Saginaw, Mich.

"YOU were going to show me how to make a fuse chart," Jack Rice reminded me, as he came across the driveway that separates our houses.

"That won't take long," I assured him. "Come in and we'll make one out for my house; then we can do the same over in your place. You see, there is a great advantage in having a fuse chart, because if a lamp fails to light or any electric device won't work and the trouble seems to be a blown fuse, it is possible to tell at a glance where to look for the defective fuse. It isn't necessary to hunt around for it as we did the other day when you had trouble in one of the upstairs circuits. There are only two fuse blocks in my house, but, nevertheless, the chart is worth making. The chart for your house, which has more circuits,



We removed two fuses, one from each block, and screwed a lamp in each vacant receptacle

can be worked out in the same way."

First we made out in duplicate a list of all the lights and convenience outlets in the house—kitchen ceiling light; kitchen convenience outlet; living room center lighting fixture; living room convenience outlet; west wall; and so on. There were seventeen.

Going to the cellar, we pulled the main house switch and put a lamp into one fuse receptacle in each fuse block, after removing the fuses from these two receptacles. We did not disturb the other two fuses. Then we closed the main switch.

"By watching these lamps," I explained to Rice, "you can tell which set of fuses protects each outlet. You stay right here with one list while I go through the house and turn on and off everything in the same order as the outlets appear on the list, from one to seventeen. When the lamp in the first fuse block lights, put down number one on the list opposite the proper outlet. When the other lamp lights, mark down number two."

This checking process was carried out quickly and the completed chart was hung opposite the fuse box for reference. Then we went over to Jack's house and used exactly the same method to prepare a chart for his much more extensive wiring system.



### Handiest Tool in Your Work Shop

PERHAPS you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No weighing, soaking or heating is required. Its quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Slow setting also allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your workshop. It is the easiest, quickest, handiest form of Glue. Insist on LePage's.

### Recipe for Making

#### LePage's Gesso

To make one cup of LePage's Gesso, you need 1 gill can of LEPAGE'S GLUE, 1 1/4 cups whiting, 3 teaspoons linseed oil and 3 teaspoons varnish. Place whiting in mixing bowl and pour in slowly in this order, LEPAGE'S GLUE, linseed oil, and varnish. Mix until smooth. All ingredients obtainable at nearest hardware store.



**LE PAGE'S**  
**GLUE**  
*Bottles, Tubes, Cans*

## Try this NEW way to improve your Craftsmanship

*LePage's New Books will show you how*

WITH the coming of the long winter evenings, the best time of the year is here for the man with the Home Work Shop Hobby. What articles of furniture are you planning to make this winter? Whether it is a radio cabinet, end table, book case, cedar chest, or any other piece of household furniture, LePage's New Books can be of practical help to you.

"LePage's Practical Suggestions for the Home Work Shop," and "LePage's Gesso-Craft Book," will help you come closer to equalling the skill of the trained cabinet maker, turning your evenings spent on this hobby to better account. They tell you how to make strong joints with glue, and not only with glue, but with glue in its most convenient form—LePage's Liquid Glue.

These books also show you how to cover up small defects in your craftsmanship. Now and then a tool will slip and an error is made. Or there are holes to be filled where nails or screws have been countersunk. Or the edges of a joint are not exactly even. A simple new way to repair these defects is with the use of LePage's Gesso instead of putty. LePage's Gesso will stick to any surface—wood, metal, glass, etc. It can be sandpapered, planed and painted or stained just like wood. We give you in the small panel at left a simple formula for making LePage's Gesso, but of course we tell you more about it in the books themselves, together with practical information on decorating your finished articles with Gesso.

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THE practical and useful help of these two books is yours for only 10 cents. Just write your name and address on the coupon below, tear the coupon out and mail it to us today with 10 cents in coin or stamps, and we will at once send you a copy of these two LePage's Books, postage paid. Address LePage's Craft League, Dept. 00-6, Gloucester, Mass. Tear out the coupon now so you will not forget it.

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## He knows

The man who has a hammer in his fist a good part of every working day picks the Maydole.

He knows that no other hammer has quite the same quality of materials and care in manufacture and inspection. The head is press-forged of selected tool steel,

each end tempered separately. The handle is of clear, second-growth hickory, air-dried for years.

If you consider it good common sense to use only the finest tools, it will pay you to insist on the genuine Maydole.

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**Hammers**

The David Maydole Hammer Co., Norwich, N.Y.

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### The Home Workshop

#### Fun in Painting Toys

(Continued from page 80)

amount and the right places, or it won't look right. It is a good idea to take a little trip through some toy shop, or the toy department of one of the big stores, and make a mental note of the color combinations."

"That seems logical," Mrs. Andrews chirped, as I paused momentarily.

"The mechanical part of the work needs to be well done," I resumed, "but there's really nothing to it, after the fine interior decorating you folks have been doing lately. In doing the new toys, the first step is to sandpaper the wood. If it is somewhat rough, cut it down to comparative smoothness with number one half sandpaper. Then smooth it off with number 00 sandpaper. Always sand with the grain of the wood."

THEN I described in detail the process of painting. It is, of course, quite possible to apply the auto enamel or lacquer directly to the bare wood, but a better finish is obtained and time is saved in the end by preparing the surface with a coat of white shellac. This seals the surface and usually saves a coat of the enamel or lacquer. The shellac dries in about half an hour, and should then be sandpapered lightly.

If there are any cracks or imperfections of the surface, they should be filled at this time with some crack filling preparation. Putty is all right if it is pure linseed oil putty. The trouble is, however, that much putty is made with paraffin oil and this will begin to show through and discolor the painted finish soon after it has been applied. There are crack filling preparations put up especially for use on wood surfaces; they cost a little more but are much better. These will not discolor succeeding paint coats; they dry hard more quickly, and are less liable to shrink and come out. One trouble with either of these materials for this purpose is that they should be allowed to dry until the next day before being painted over.

When it is desirable to finish up the work the same day, about the best thing is to mix up some plaster of Paris or whiting with white shellac or lacquer. This will dry so hard within an hour that it can be sandpapered level and smooth.

TWO coats of either enamel or lacquer ought to be enough over the shellac, but a third coat sometimes may be necessary. If auto enamel is used, allow forty-eight hours for drying, and sandpaper lightly between coats. If lacquer is used, the sandpapering between coats may be dispensed with; in fact, it will be better not to sandpaper if you are going to follow one coat after another within an hour or so. Lacquers, while they are dry to the touch within a few minutes after application, continue to harden for quite a few hours, and if the lacquer is to be sanded it should be dry clear through. Another thing to remember is that lacquer will not stand so much sandpapering as oil paints and varnishes, and should never be sandpapered dry. (Continued on page 105)

### WET CELLARS MADE DRY from the Inside!

DAMP musty cellars are unsanitary, a danger to health and a poor place to store valuable material.

Where water or moisture seep in through cracks or porous spots in the floor or walls, you can make and keep your cellar dry and sweet—a fit place to work, free from odor, mold and rust—by filling the cracks and coating the moist surface with Smooth-On No. 7.

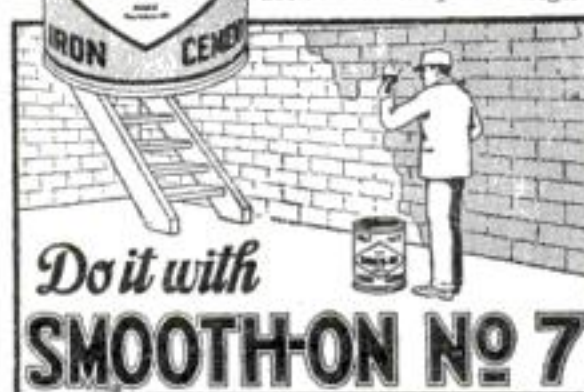
This is the one practical waterproofing that you can apply yourself, easily, from the inside, to wet or dry surface and with every assurance of thorough watertightness, even in the wettest seasons.



Write for  
**FREE BOOK**

Excellent also for patching concrete floors, waterproofing garage, stable and washroom floors, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds, swimming pools, manure pits, etc.

About 25 pounds of Smooth-On No. 7 are required for each 100 square feet of surface covered, and no experience is necessary. Complete instructions on the package. Sold in 5-pound cans and 25, 50 and 100-pound kegs.

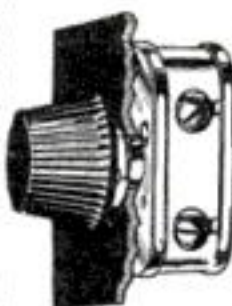


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Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

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Electric Controlling Apparatus  
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## The Home Workshop

### Fun in Painting Toys

(Continued from page 104)

The dry paper scars the lacquer film. Get the special type of sandpaper made for use with water and keep it wet.

After sandpapering, always be sure to dust off the surfaces. About the only other thing to remember is to watch out for sags or beads forming and running down at the corners and edges, also "curtains" on upright surfaces. When seen, these should be "picked up" or "straightened out" with the brush at once, before the material has commenced to set.

As toys generally are more or less irregular in design, care is essential so as not to cut through at the edges or corners in sandpapering, and not to miss any places in applying each coat. Look over every part carefully for skipped places.

In refinishing old toys, simply wash them, sandpaper lightly and give them a coat of enamel or lacquer. One coat ordinarily is enough for a repaint job, but if not, apply another.

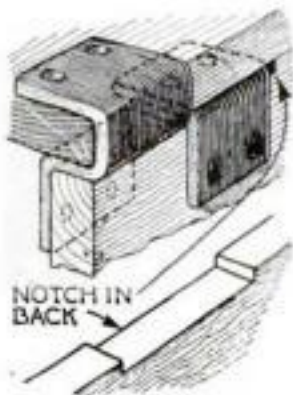
"With these pointers we'll surely make a good job of it," Mr. Andrews asserted when I had finished.

"There's one thing more," I added. "The finish wants to be flowed on smoothly and evenly, without showing brush marks. You'll need good brushes if you want a good job. About a one and a half or a two-inch brush will do nicely for this work. And then you ought to have a smaller brush—about a half inch—for putting on the trim color and other small work."

"Now then, we're all set for playing Santa Claus!" exclaimed Mrs. Andrews.

### How to Apply Leather Hinges

LEATHER hinges, if used on the lids of boxes or chests around the shop and home, should each consist of two pieces. One is fastened to the underside of the lid and passes through a recess in the edge of the box so that it can be attached to the outside of the back. The adjacent piece is attached to the outside of the top, passes through the recess, and is fastened inside the back. The lid cannot slide forward and backward.



Each hinge requires two leather strips

Either screws or nails long enough to be clinched may be used for attaching leather hinges.—HAROLD N. WHITMORE.

AN EASY way to remove lint, waste or other fuzzy matter from a metal strainer or screen is to dip it into gasoline and light it with a match. The charred waste material then can be blown or shaken off. If the screen is soldered, the waste must be lit and extinguished repeatedly to avoid any chance of the solder's melting.

THE annual question is in everybody's mind. The annual gift list is in everybody's pocket. Here is just the right present for son or daughter, for best friend, for close business associate—in fact

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The Remington Portable Typewriter may be selected with the assurance that it is the recognized leader—in sales and popularity. It meets every requirement of personal writing. It is the world's lightest writing machine with standard keyboard—tips the scales at only 8½ pounds net. And it is the most compact of all typewriters—fits in a carrying case only four inches high.

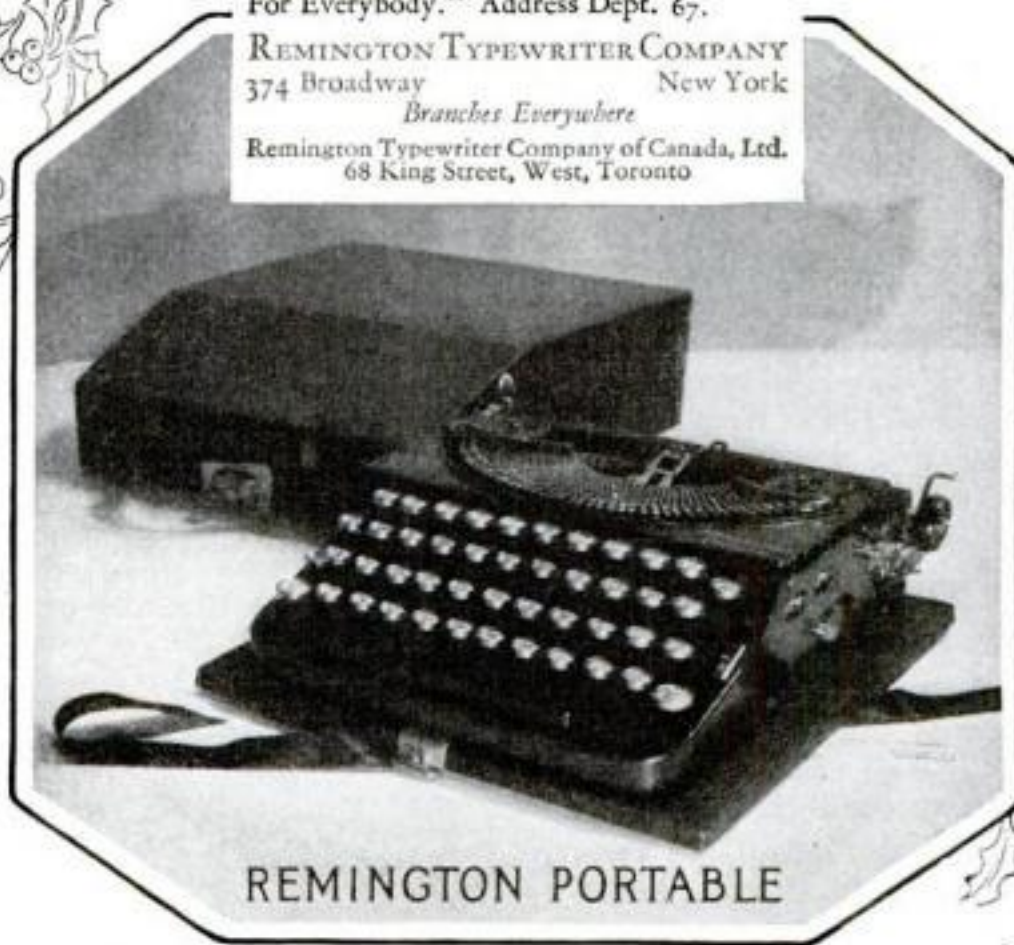
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## Aerials have gone out of style

In the old days, when radio was new, the "fan" was known by crazy festoons of wire that decorated his housetop or yard. These were the old-fashioned aerials, and no one has forgotten all the grief they caused.

Modern radio may use the hidden loop, or the short indoor aerial. But there is a better way. The Dubilier Ducon enables you to use the complete wiring system of your house without risk, and with better results than most outdoor aerials give.

You simply screw a Dubilier Ducon into any lamp socket, and connect it with the antenna binding post of your set. You will find that it increases selectivity—especially in crowded neighborhoods, and will reduce "static" in the summertime.

Try a Dubilier Ducon on your set tonight. They are sold by all good dealers on five days' trial for \$1.50.

# Dubilier

CONDENSER AND RADIO CORPORATION

4377 Bronx Blvd., New York, N. Y.

## The Home Workshop

### Automatic Block System

(Continued from page 70)

be hidden away under some of the scenery if you want to keep it out of sight.

The wooden arm is  $\frac{1}{2}$  in. square and 5 in. long. A hole for a thin  $1\frac{1}{4}$ -in. wood screw is bored through one end of the arm. Make the hole big enough so that the screw will be a loose fit. Mount the arm on the base with one fiber washer between the arm and the base and another under the screw head. Adjusting the screw will regulate the amount of effort needed to move the arm. The lower washer also supports the arm sufficiently far above the base so that you can wind on some soft iron wire to act as an armature and still have the arm swing clear.

**Y**OU will need soft iron wire of any gage not larger than No. 14 to make the armature on the moving arm and for the cores of the two electric magnets. If you have wire of approximately No. 14 gage, use between 15 and 20 turns on the movable arm or an equivalent bulk of smaller wire.

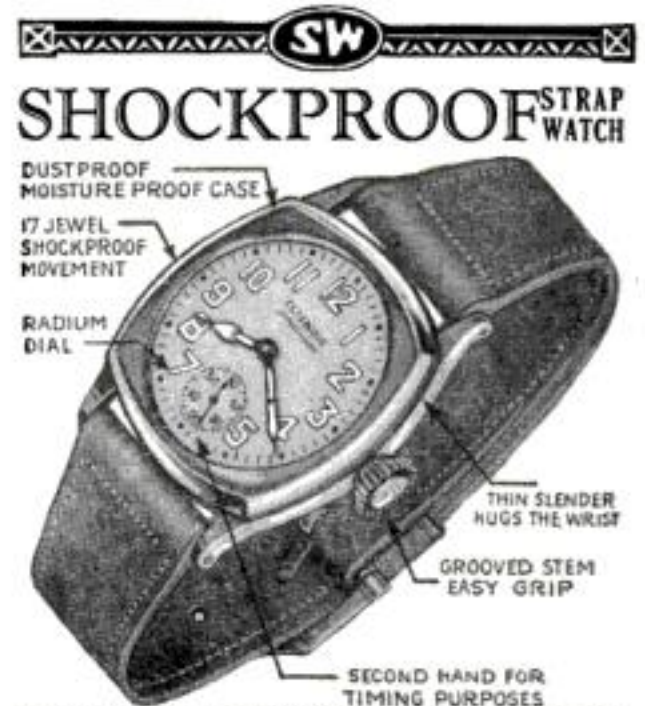
The next step is to construct the magnets. Use enough pieces  $2\frac{1}{4}$  in. long to make a core about  $\frac{1}{2}$  in. in diameter and wind with one layer of friction tape. Then wind on three or four smooth layers of No. 22 cotton or silk insulated wire. The number of turns and the size of wire can be varied within rather wide limits and the device still will work perfectly. Avoid many turns of very fine wire, however, if you intend to use the device on alternating current, as the increase in the number of turns will make the magnet weaker instead of stronger.

After you have wound the wire on each magnet, put on a couple of layers of friction tape to protect the insulation. Then you can mount them on the base as shown in Fig. 2. They are clamped down by means of wire straps with a small wood screw through a loop bent in each end of each strap. This construction will allow you to change the position of each magnet with relation to the armature and so adjust the motion of the armature.

**CLAMP** the magnets loosely in place as the final adjustment must be made under operating conditions.

Now fit to the free end of the arm two sheet brass contacts as shown in Figs. 2 and 3, and mount on the base two brass contacts so placed that they will engage with the contacts on the arm. The simplest way to mount each of the contacts on the base is by means of a pair of round-headed wood screws as shown in Fig. 2. Don't waste any time now in adjusting the spacing of the contacts as this, also, must be done after the system is set up and the current is turned on. You can, however, make sure that the contact on the arm is bent so that it will slide over the edge of the contact on the base in each case.

Next mount six screws on the front edge of the base to act as binding posts and you are ready to begin the installation and wiring. (Continued on page 107)



**A TRIUMPH!** Illinois "Sportsman"—the 2-in-1 Strap Watch—for DRESS Wear; for SPORTS Wear. Has remarkable SHOCK-PROOF movement, double strength mainspring, steel wheels, plates, escapement, secret process tempered. Genuine Ruby Jewels—not 7 or 15—but 17 jewels for PRECISION! Created by ILLINOIS WATCH CO., Springfield, Illinois. The U. S. Government, during the World War, requested their entire output of Military Watches because they were conceded best.

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**B**USINESS MEN, Professional Men, Executives, Sportsmen are ASTOUNDED at its Splendid Performance under action! Terrific drives down the fairway, smashes on the tennis courts; winter sports; motorcycling, hunting, intense heat or cold do not affect its timekeeping! It's SHOCK-PROOF! WEATHER-PROOF! Enthusiastic owners praise its ACCURACY and RICH BEAUTY! Case is DUST-PROOF! MOISTURE-PROOF! Green or White Gold Filled. Radium dial GLOWS time BRIGHTLY in Darkness! For Red-blooded Men! \$50-List. Our price for LIMITED TIME **\$33<sup>95</sup>** to advertise our Direct-to-User value.

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JERRY SULLIVAN—Director and Announcer—WBBU-CAW-go



## The Home Workshop

### Automatic Block System

(Continued from page 106)

The electromagnetic switch can be placed wherever convenient, although it is desirable to have it near the signal tower to cut down the amount of wire needed to make connections. The tower for the red and green lights can be made up in any desired form. In the experimental installation shown in the illustration, an old burned-out thermostatic control tower was used after all the mechanism had been removed except the red and green lights.

The section of the third rail that carries the current to the collector rollers on the locomotives (marked O in the diagram) must be insulated at both ends by pulling out the connecting pins. The insulated portion should be about three or four track sections in length or long enough so when the current is cut off from this part of the track the oncoming train will not coast clear beyond it.

Now study Fig. 4, which shows the way to bend the heavy wire contacts A and B.

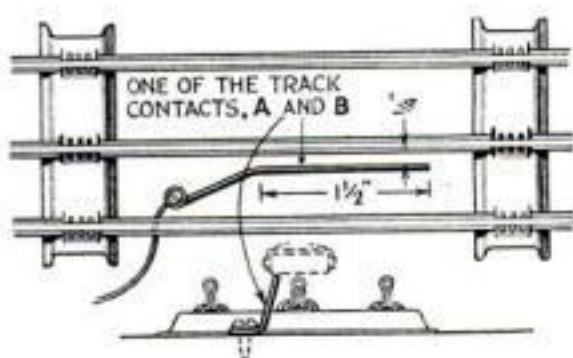


Fig. 4. Electric locomotives are made with double roller collectors. One roller contacts with wire; the other rests on the third rail

These should be fastened to the floor or a light wooden board under the track in such a way that the upper straight section of each contact will be parallel to the third rail and about  $\frac{1}{4}$  in. from it. The straight sections of the contacts, which should be slightly higher than the third rail, must not touch either the third rail or the outside rails.

Use ordinary bell wire for all connections. No. 1 binding post (Fig. 3) is connected to one wire from each magnet, to one terminal of each of two lights and to the outside track rail at the nearest point. The remaining wire from magnet D is connected to binding post No. 2 and track contact A also is connected to this binding post. Contact Y is connected to binding post No. 3, and the remaining terminal of the green light and the insulated third rail O also are connected to this binding post.

Connect contact X and the remaining terminal of the red light to binding post No. 4. Connect the remaining wire from magnet C and the track contact B to binding post No. 5. Then run a flexible wire from both of the contacts on the movable arm to binding post No. 6 and also connect this binding post to the third rail at any point except section O. This completes the installation and wiring and you are ready for a trial run and the adjustment (Continued on page 108)



## The phone never rings for Jim —perhaps it's comedones\*

Time after time Jim answers the phone only to say, "Here, Walter, it's for you." And that's the way it is with everything so far as Jim is concerned. He's usually neglected—seldom counted in—often counted out. He never thought to blame it all on comedones.

A great many young men suffer from comedones—commonly called blackheads. Skin can't be clean-looking, fresh, wholesome, if these disfiguring formations are present.

What's more, you may not even be conscious of comedones. But your friends notice them. You may wonder why invitations become fewer—why friends—girls in particular—seem to avoid you. You may never guess. Perhaps it's comedones.

Pompeian Massage Cream helps you overcome comedones. It gives you a clean, clear, ruddy complexion. It

gets into the pores where comedones form, rolls out all dirt and oily secretions, and stimulates a healthy circulation, keeping skin clean, pores open.

### Try this treatment

After you shave, spread Pompeian Massage Cream generously over your face—and rub. Continue to rub until the cream rolls out. Note how dark the cream looks. That's the dirt that was in your pores.

Don't let comedones form. Use Pompeian Massage Cream every day—especially when social or business engagements demand that you look your best. It means a healthy, wholesome skin. It means more joy in living.



Use at Home after Shaving

To get full pleasure and benefit, use Pompeian Massage Cream regularly at home after shaving. Your face will feel and look like a million dollars. 60c jar at all drug stores.

### \*WHAT ARE COMEDONES?

(pronounced cūm'e-dōnes)

Dictionary definition: A small plug or mass occluding the excretory duct of a sebaceous gland, occurring frequently upon the face, especially the nose. It is often called black-head.

### SEND FOR 10-DAY TRIAL TUBE



For Men!

For 10c we will send a special trial tube containing sufficient cream for many delightful massages. Positively only one trial tube to a family on this exceptional offer. Use this coupon now.

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## Hewing to the line is easy with this chisel-edge claw Hammer

HERE is something new in hammers. The one-pound head of forged steel carefully tempered has a chisel-edge on the end of the claws. It is perfectly balanced and the two extra side claws makes it possible to pull nails in close corners or next to the wall.

The distinct curve to the claws creates a fulcrum that makes it possible to pull out large nails with one pull.

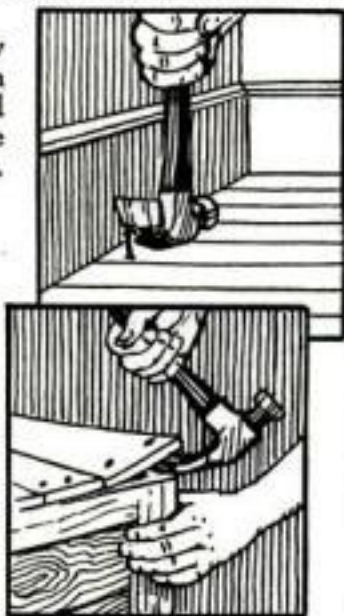
The chisel-edge claw hammer has been tested and approved by the Popular Science Institute of Standards.

Every man doing carpentry work or odd jobs around the house will find hundreds of uses for the three-in-one hammer. It will do everything any other hammer will do. Besides it can be used as a chisel and it will get at nails that other hammers won't reach. The price for this new hammer is only \$2.00.

If your hardware dealer hasn't the chisel-edge claw hammer in stock write to us sending his name and we will fill your order direct

Chisel-Edge Claw Hammer Company  
H. A. Ayvad Hoboken, N. J.

# CHISEL-EDGE CLAW HAMMER



## The Home Workshop

### Automatic Block System

(Continued from page 107)

of the positions of the magnets and the contacts X and Y.

Assuming that the arm is to the right so that contact Y is closed, you will note that the green light will be lighted and current will be supplied to section O of the third rail so that a train traveling in the direction of the arrow will run across section O without stopping. Just after it has left section O, the collector roller on the locomotive will strike contact B, and the current will flow through the windings of magnet C. The movable arm will be pulled over to break contact Y and close contact X. This will result in shutting off the green light and turning on the red light and at the same time the current to third rail section O will be cut off. A train following the first one will therefore stop when it runs onto section O, and it will remain standing in front of the red light in the signal tower until the first train has traveled as far as contact A, when current will flow through the windings of magnet D. The movable arm will be pulled back into the first position, breaking contact X and again closing Y. The light will change from red to green and current will flow to third rail section O, whereupon the second train will start up and continue around the track. The distance between contacts A and B will depend on the length of the trains you are running and the size of your track layout.

YOU will find that the best adjustment for the magnets C and D and the contacts X and Y is such that the movable arm has the smallest possible movement that will completely break and make the contacts. If you get too little motion, both lights will have a tendency to stay lighted at the same time, and too great motion will prevent operation. The friction on the movable arm should be adjusted by setting the screw so that there is just enough friction to keep the arm in the position to which it is moved by the pull of the magnets.

If a single train is operated around the track, nothing happens except that the signal tower lights change from green to red and back again each time the train passes the contacts A and B. The system will operate only for trains traveling in the direction of the arrow. If you run a train in the opposite direction, it will stop itself in section O and will remain there until the movable arm is reset by hand.

### Block for Cracking Nuts

A HEAVY hardwood block with several shallow holes bored in it is a help in cracking any large quantity of hard-shell nuts. There should be a hole for butternuts, another for walnuts, and so on; in each instance the nut should project about one-third its length above the surface of the block. A sharp rap with a hammer on the end of the nut cracks the shell without scattering the pieces.

## A Handy Small Table



## Would you like to

own this combination end table and book trough? Bought in a store this end table would cost \$20 to \$25. If you make it yourself it will cost you only \$5 or so for the hardwood, and the finishing materials.

If you can use a hammer and saw you can easily make this handy table from Home Workshop Blueprint No. 3 which will be sent on receipt of 25c. Blueprints mailed the day order is received.

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## The Home Workshop

# This Peanut Duck Walks Downhill

By GEORGE D. HUGO

ONE sunny double-header afternoon I searched between innings in my bag of peanuts for those of a certain shape and size and, as the slender result of my watchfulness, carried home half a dozen selected roasts in my vest pocket. These were for the construction of a walking duck.

A duck was wanted (Fig. 1) that would waddle realistically down an incline—

Fig. 1. The duck is going for his walk



Fig. 2. The hobbyhorse walking boy

something to amuse the kiddies and, possibly, those grown-ups who might happen to see the toy in action. There is on the market a very popular wooden walking toy that works on an ingenious balancing principle, and it seemed that one might take the liberty of adapting this idea on a miniature scale to a peanut novelty.

With peanuts of a promising shape at hand, few other materials were needed—a bit of  $\frac{1}{8}$  in. thick cardboard (wall-board), a couple of wire nails, and a feather plucked from an unsuspecting pillow.

First to find the center of gravity of one of the peanuts! For a while I did not think that (Continued on page 110)

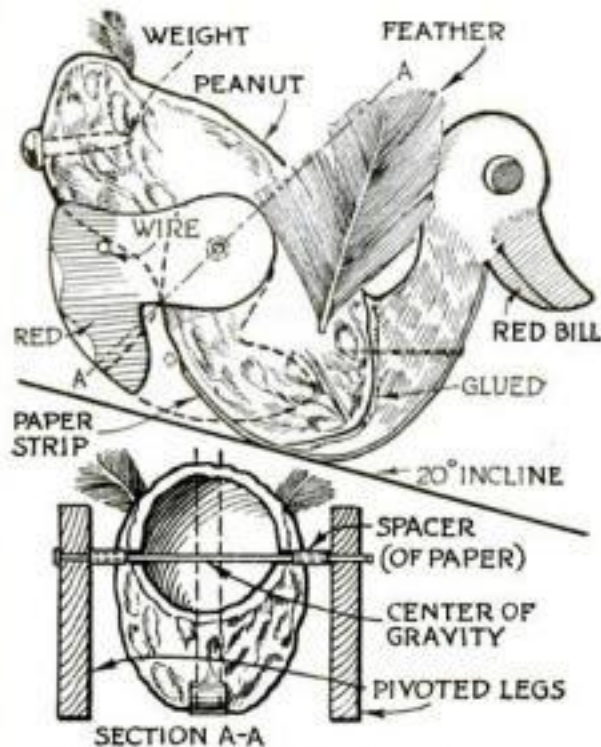
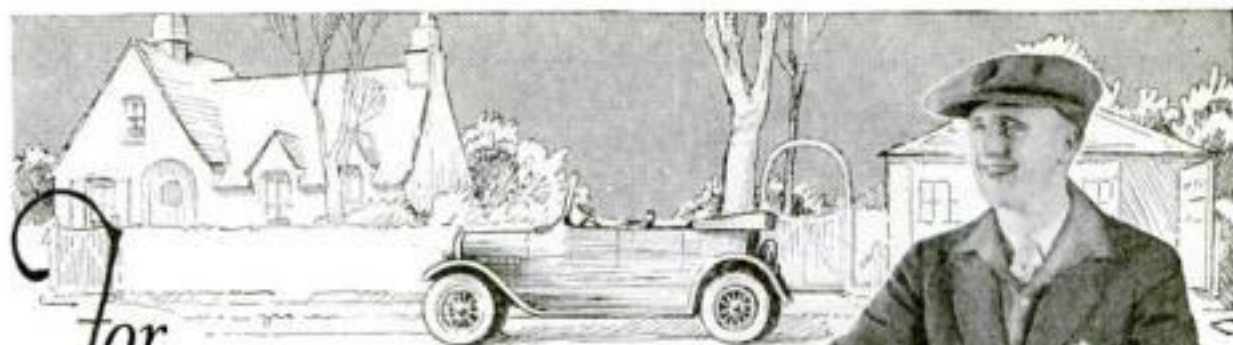


Fig. 3. A full size side view of the peanut duck and a section through the body and legs



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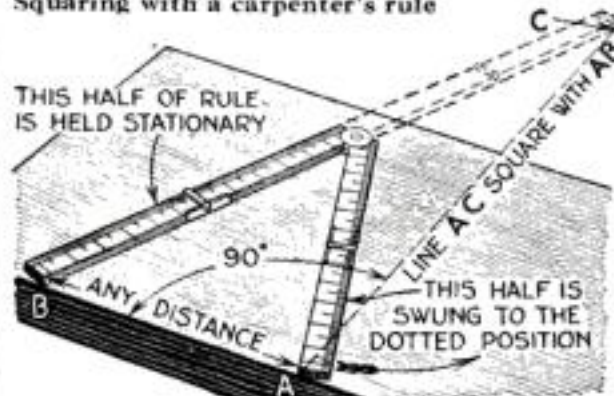
## SOUTH BEND LATHES

## The Home Workshop

### How to Square a Board with a Folding Rule

WHEN no square is at hand, a carpenter's two-foot folding rule may be used for drawing a line squarely across a board. Place the rule as illustrated, with

Squaring with a carpenter's rule



the legs separated any convenient distance. Then hold the leg that touches B in its place and swing the other leg from A as far as it will go. A line from A to C then will be at right angles to AB.—W. J. E.

### This Peanut Duck Walks

(Continued from page 100)

particular peanut had any, but it was there, after all. Slightly above that point a hole was drilled horizontally through the peanut for pivoting the legs. Through this hole the clavicle, if that's the right name, was passed; it's really a thin wire nail. On each end were mounted the round-bottomed legs, which were cut from the wallboard as shown. To form loose-tube spacers between them and the body, tiny strips of paper were coated with glue and wound around the nail.

Beneath the body the feet were connected by means of another nail, placed at the point indicated in the side view (Fig. 3). This serves to lift the rear end of the body and causes it to roll forward upon its chest at a certain point in the duck's progress, so that the legs will swing one step forward, ahead of the center of gravity. Then, as the feet make contact with the ground, the heavier tail end lowers itself, only to be lifted again by the connecting bar of the rolling feet. The movements continue with a smoothness and regularity that is astonishing.

The chest and tail limit the stride, but to balance the duck properly, it was necessary to stick a heavy escutcheon pin in the tail end, as indicated in Fig. 3.

The head and neck were cut from wallboard and glued in place. The joint was reinforced with a strip of paper. Finally the wing and tail feathers were added and the toy was painted.

The other novelty, illustrated in Fig. 2, works on the same principle, but both body and legs were cut from wallboard. The pivot pin—just an ordinary sewing pin—has a bit of paper wrapped around it on each side of the body to serve as spacing sleeves similar to those used in the duck. A second pin passes through the boy's feet and keeps them the proper distance apart. Another is pressed into the horse's body, as shown, to regulate the stride; it stops the swing of the second pin at the completion of each step.



## The Home Workshop

### How to Utilize a Cellar

(Continued from page 82)

and later potted to be transplanted into the open ground when the season is suitable. Moreover, these plants can gradually be made hardy so that they will not stop growing, as many greenhouse plants do when set in the open ground, and, therefore, they will be in bloom weeks before the ordinary hothouse-grown plants. This factor will be attractive to a gardener living in a locality where cold nights continue rather late in the spring.

It is advisable for anyone who wishes to have a frame to fit up a small shop in the basement so that he may make his own trays. The writer has done all the work of building and maintaining his frame in his own little shop and is also able, because of having the shop, to make many useful articles for the house and garden.

Besides the economic side of this venture—it insures a saving in florists' bills—many enjoyable hours can be spent in this most wholesome recreation. The writer has found that his own little girl would rather spend her play hours with him in the basement than with her toys upstairs. A play nook in the cellar will be greatly enjoyed by any child.

### How I Remodeled the Cellar of an Old-Fashioned House

By MRS. A. E. H. CRESWICKE  
Barrie, Ont., Canada

THE front cellar of our twelve-room house had never had the floor cemented. It was constantly damp and sometimes flooded in the spring. This had destroyed the lower bricks of four brick pillars supporting the center beam under the main floor and consequently the whole house had sunk in the center.

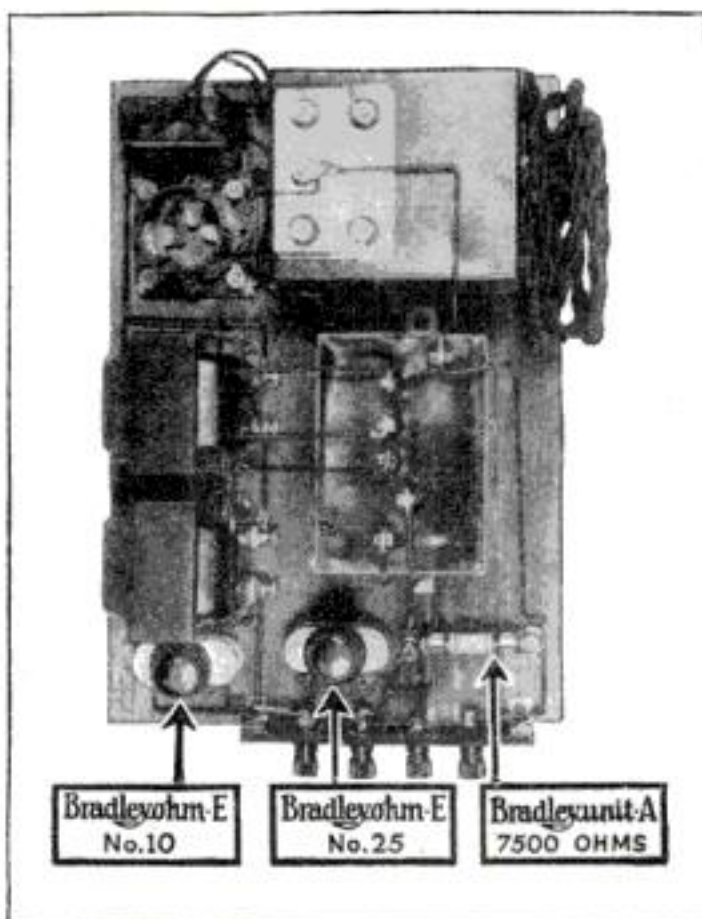
To support the beams, I had a cement partition made, allowing for two doorways. The floor of the whole cellar was tiled and drained into a trap. A partition of plaster wallboard then was built to divide half the cellar in two. This gave a big laundry and a large storeroom, each with a window.

The other half of the cellar, with the furnace in it, was objectionably dusty. Using 2 by 2 in. studding, I nailed a strip across the bottom of the main floor joists along one side of the furnace hole. Then, with a plumb bob, I found the exact line below it to lay another length on the floor. Between these I fitted 2 by 2 in. uprights, spacing them 16 in. from center to center. Two more studs were nailed to adjacent sides of the corner pieces to strengthen the corner and provide support for the wallboard.

I nailed the wallboard on to make a close wall and thus confined the dust entirely to the furnace room and the 14-ton coal bin. Plaster of Paris mixed with flour paste so that it would not set quickly was used to fill all joints and cracks.

The nailing was done with a shoemaker's hammer, as it seemed to be well balanced and the big, flat head did not ding the wallboard. The

(Continued on page 112)

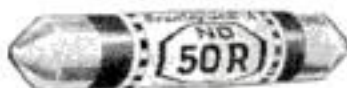


## What a whale of a difference a few Bradleyohms make —in a B-Eliminator!



### Bradleyohm-E

For B-eliminator service requiring wide voltage control, Bradleyohm-E is essential. It is an oversize Bradleyohm with sufficient capacity to handle all normal B-eliminator requirements. Be sure to ask for Bradleyohm-E in the checkered carton. Your dealer can get them for you.



### Bradleyunit-A

This solid, molded, fixed resistor has no glass or hermetic sealing in its construction. It is a solid unit with silver-plated end caps that are not affected by temperature, moisture and age. By all means, use Bradleyunit-A when you need a fixed resistor.

MAGAZINES and newspapers have been publishing circuits and instructions for assembling B-eliminators. Many types of kits have been used, but the outstanding feature has been the almost unanimous recommendation to use Bradleyohm-E for plate voltage control and Bradleyunit-A for the fixed resistor.

The leading manufacturers of B-eliminators have long since adopted Allen-Bradley variable and fixed resistors as standard equipment for their B-eliminators. In fact, the Bradleyohm-E has become almost as universally used in Raytheon tube B-eliminators as the Raytheon tube itself. The scientifically-treated graphite discs in these remarkable units have never been equaled for silent, stepless plate voltage control so essential for the satisfactory operation of a radio set with a B-eliminator.

When you build your B-eliminator, always insist that Bradleyohm-E and Bradleyunit-A are included with kit. You then will be assured of perfect voltage control. Send for folder "How to Build a B-eliminator" describing seven popular hookups.

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DEPT. B-250 CHICAGO



## The Home Workshop

### How I Remodeled a Cellar

(Continued from page 111)

sawing was done with a pruning saw. The fine teeth I found good for starting a cut and the big teeth for doing the work quickly. For the door, I used a well-battered storm door.

This left me with one quarter of the cellar still to be used. In that I installed a workshop, as I have been buying POPULAR SCIENCE MONTHLY for some months and had become properly enthused with the desirability of having a place for tinkering. I made a workbench and on the back board fastened a length of metal linoleum binding with large-headed roofing nails, to provide holders for some of the tools.

A wooden vise was made, a metal vise purchased, and half of a butt hinge screwed to the bench near the left end of the top to form a stop for work being planed. A tea box filled with cigarette boxes makes a fine cabinet for small articles. Three raisin boxes, one above the other, with three pieces joining the sides so that they can be pulled out until all are uncovered, and a piece on the back for a leg, serve as a handy tool chest.

In this little shop I have repaired several chairs, done over a walnut table, a walnut sideboard and much other work.

At present, having attended a motor mechanic's class two nights a week for several months, I am getting my car into shape.

Further plans for the cellar are to lay a floor of cork carpet 7 by 15 ft. in my workshop and to build a great set of shelving. I also intend to cut off one end of the storeroom with another wallboard partition and run the water service pipes back and forth many times across the ceiling before they go up to the taps. The fresh, cold water will keep the pipes cool and make it a cold storage room. It will have shelving added, of course, and hooks for provisions.

### Dust Chute from Kitchen to Cellar Saves Footsteps

By IRVIN RITTENHOUSE

Point Pleasant, N. J.

HERE is an idea for utilizing a small space in a cellar that will save the housewife much work. I placed it in my house. A builder saw it. He has placed it in several houses he has since built.

While most up-to-date housewives have a vacuum cleaner, brooms are still much used, especially in a kitchen. To eliminate the dustpan and receptacles for catching sweepings, cut an opening in the kitchen floor between two joists near the wall. Make a hinged drop door flush with the floor, with a flush ring pull. Place the hinged side, if possible, so near the wall that the door will not remain open except when held up with one foot while the sweepings are being brushed into it. This will insure the drop always being closed when not in use.

From the opening in the floor, build a straight, (Continued on page 113)

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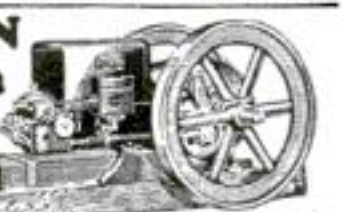
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## The Home Workshop

### Dust Chute to Cellar

(Continued from page 112)

square chute of any light wood to reach almost down to the top of a sugar or flour barrel. Tack canvas or other cloth to the chute so that it will hang down over the barrel and prevent dust from getting into the cellar.

To save stooping to lift the trap, a stick or rod with a hook attached to it may be kept hanging on the wall near by.

### How to Partition Off a Cold Room in a Cellar Corner

By DANIEL SMILEY, JR.  
Mohonk Lake, N. Y.

BESIDES the regular coal bins, wood boxes, trash barrels and furnace, we have a carpenter's bench and workshop, similar to that described in the April issue of POPULAR SCIENCE MONTHLY. One of the more unusual features is a cold cellar, a convenience almost always found in the old country houses, but, I think, very seldom in modern houses.

It is partitioned from the main cellar by 2 by 4 in. studding and regular wooden siding. The north corner is used so that the cement wall keeps it cool on two sides. On the siding we placed ordinary paper, but now one can get much better insulating material cheaply. This material also should be placed on the lower side of the first floor beams. The smaller the window or windows opening into the cold room, the better. The interior is whitewashed.

Another feature of our cellar is a bathroom with a large shower bath for the use of workmen.

### Small Brooder House Built Outside Cellar Window

By A. K. KIMBLE  
Marion, Kans.

I REVERSED three windows on one side of my cellar so that they swing outward and then from some old packing cases built a platform 3 by 9 ft., level with the windows. This was to serve as the floor of a small brooder house. Sides were erected and a hinged back put on. The floor was so arranged that it could be taken out for cleaning.

In front of the windows I built a small pen. As the furnace room is always warm, this arrangement makes an ideal brooder house for small chicks.

### Builds a Band Saw Cheaply

IT MAY interest you to know that I have just completed one of the ball-bearing band saws designed by Mr. Ray F. Kuns and described in the February issue of POPULAR SCIENCE MONTHLY. The saw works perfectly and was made at a cost of \$23.77. A saw of the same size, if purchased in the ordinary way, costs \$75.—H.S.M., Veazie, Me.



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## The NEW "Aristocrat" Vernier Port Dial



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The Aristocrat Vernier Port Dial is supplied in three attractive finishes to match any radio—black with white markings, mahogany and walnut with gold markings. The price is \$2 each—in the finish you prefer. With a complete set of three Aristocrats, we are making a special limited offer. We are giving away the beautiful, 48-page, authentic Log Book illustrated here. You'll appreciate this gift when you see it. Ask the better radio dealer near you to show it to you.

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## The Shipshape Home

### The Expert's Way of Repairing a Shingled Roof

By A. E. ELLING

**H**AVE you ever watched a carpenter neatly and speedily inlaying bright patches of new shingles in an old roof and said to yourself: "I wish I knew the trick of doing that so that I could fix those leaks in my own house"? It isn't really hard; you can do just as satisfactory, if not so rapid a job as an expert shingler.

In repairing a roof it is of primary importance to ascertain the spots where the leaks originate. That sometimes is the most difficult part of the task. It often calls for careful sleuthing in the attic, with faint water marks for clues.

A leak may be found quite a distance from the defacing rain stains on the ceil-



Fig. 1. Completing repairs around a chimney by cementing counter flashing in place

ing and walls of the room beneath. At times rain water will follow down a rafter or roof board a long way before leaking into the house. The attic right under the shingles affords the best information.

When the leak or leaks have been traced, push a thin wire finishing nail up through the shingles to indicate on the outside where the patching must be done.

If it is not possible to examine the underside of the roof and the outside alone must be the guide, look the shingles over carefully just above where the leak shows in the room below. The shingles may appear to be sound there; in that case, search higher up wherever it seems likely that the rafters or boards may carry water down after it has penetrated beneath the shingles.

The first thing you will ask when you come to under- (Continued on page 115)



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NC4 Naval Seaplane—4 1/2 ft. size	Complete Construction Outfit.....	10.00
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Cecil Pooler Racer	

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## The Shipshape Home

### Repairing a Shingled Roof

(Continued from page 114)

take the repairs, is: "How shall I get up and work on the roof?"

An iron roof hook, which goes over the ridge, may be obtained at many hardware stores. This is fastened at the end of a light ladder, which is pushed up on the roof until the hook drops over the ridge. In place of a ladder, a long board with evenly-spaced cleats may be used.

Another method is to nail a sound 1 by 2 in. shingle lath (these commonly come in lengths of 12, 14 and 16 ft.) on to the butts of the shingles so that an eightpenny nail will go through into the shingle lath below. Do not drive the nailheads right in; let the heads project so that they can be gripped and drawn out easily.

Laths made in the form of a ladder, only wider than usual, may be used as illustrated in Fig. 1. Drive about four nails in the roof to hold this support in place. When these or any other nails are withdrawn from the roof, each of the holes should be stopped with roof cement.

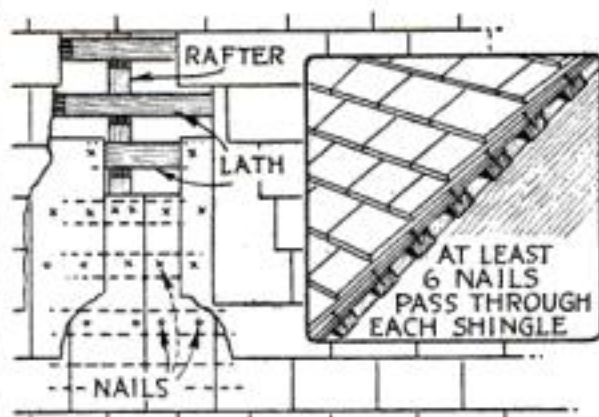


Fig. 2. How shingles are laid. Each nail ordinarily passes through three shingles

If the nails have been driven into but not entirely through the shingle lath (and not right through the shingles into the attic) there is little danger that a leak will develop, even when no roofing cement is used, but it pays to be on the safe side.

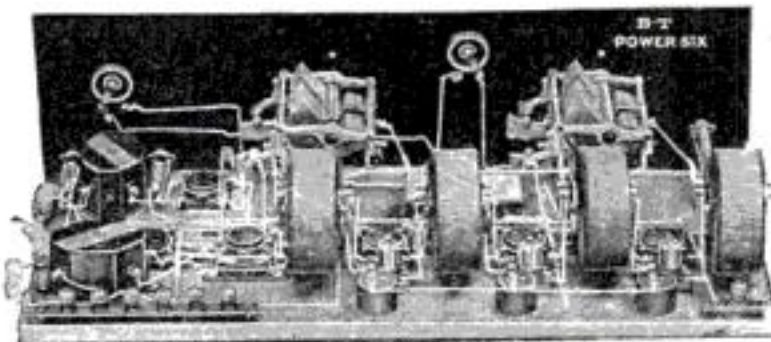
Shingles may be bought by the bundle from any retail lumber dealer. There are between 200 and 250 shingles in a bundle. The lengths are uniform and should be 18 in. for roof shingles and 16 in. for wall shingles. The widths, however, are random and vary considerably. Shingle nails, preferably fourpenny in size, are used for fastening the shingles.

Be sure to have on hand heavy tar paper, a tarpaulin or something of the kind to close up the opening in the roof quickly in case of a sudden storm.

One of the simplest types of repair is when there is a crack through two shingles, one right above the other. This may be mended by pushing strips of painted roofing tin about 7 in. long up under the shingles. If the strips are put in the full distance, they will, in effect, overlap each other and shed the rain.

If the shingles are too far gone and one or more new shingles must be inserted, remove the old shingles by splitting them up with a hatchet or chisel. Hammer them into small pieces and no trouble will be found in (Continued on page 116)

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The New Bremer-Tully Power-Six is a revision of the famous Counterphase Circuit to take advantage of the latest improvements in tubes, resistances and parts.

It is easier to build, balance and operate.

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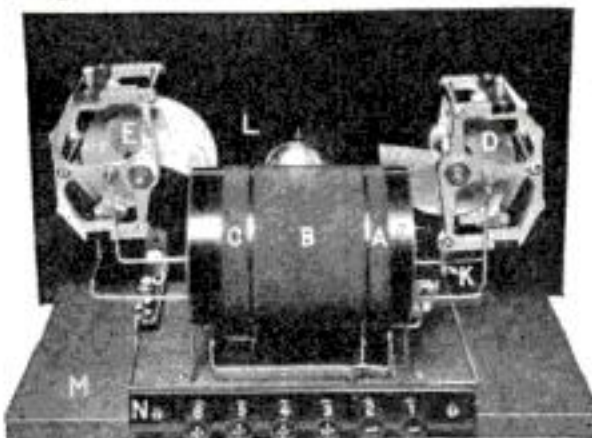
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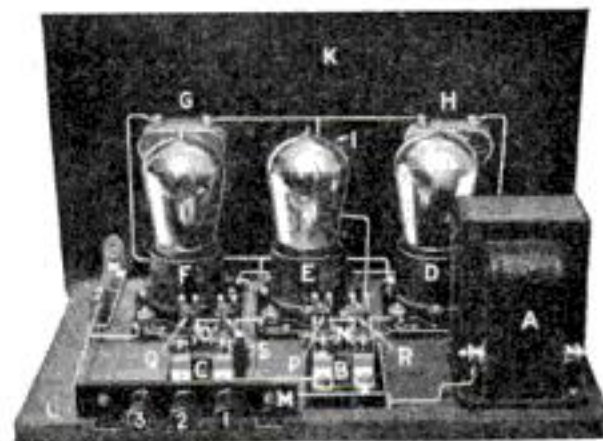
Describes a simple, one-tube regenerative receiver of the fixed coil type. The regeneration is controlled by a variable condenser and does not affect the wavelength adjustment. Quality of reproduction is excellent because no audio frequency current flows through the tickler coil. The coil is hand wound and the rest of the parts can be of any standard make.



**Four Tube Radio Receiver**  
Blueprint No. 43—Price, 25 cents

Describes a four-tube radio receiver consisting of one stage of radio frequency

amplification, a regenerative detector, and two stages of transformer coupled audio amplification. It gives the greatest power for distance and volume that is obtainable from four tubes. Easy to build, uses any standard parts except the coils, which are simple to wind by hand. Two control tuning and regeneration does not affect wavelength adjustment.



**Three-Stage Amplifier**  
Blueprint No. 42—Price, 25 cents

Describes a three-stage audio amplifier to be added to one tube set of No. 41 to obtain loudspeaker results. Is equally useful with any other standard one-tube detector circuit. Consists of one stage of transformer coupling, followed by two stages of resistance coupling. Volume control is simple and does not affect quality of reproduction. This blueprint does not describe a radio receiver—it is simply an audio amplifier to be used in connection with a one-tube radio receiver.

POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City



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**To Retail Tobacco Merchants:** If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in on WRVA, Richmond, Va. —the Edgeworth Station. Wave length 256 meters.



## The Shipshape Home

### Repairing a Shingled Roof

(Continued from page 115)

taking them out quickly, bit by bit.

Before the new shingles can be placed, however, the old nails must be removed. By examining Fig. 2, it will be seen that at least six nails have had a grip on each shingle; wide shingles have more. Four or more of these nails must be either broken off, bent over and flattened down, or drawn out. A tool used by slate roofers and known as a ripper will serve to draw them out, no matter how far they are hidden, but it is not a tool easily obtained. Many carpenters also carry long, thin, narrow saws tempered to cut nails in repair jobs of all sorts, when these nails cannot be reached otherwise.

**T**HE work can be done with a thin pry-bar or a long, thin prying chisel. Drive it up against the nails to break them off, or bend them over and flatten them. In removing old shingles to make a patch, break out the top ones first, and the others will come easily. In breaking out the old shingles be sure to leave overlapping pieces so that no two of the new joints will come one above another.

Fig. 1 shows the method of shingling and you can see just what to do, in any case, by observing the way the original shingles were laid.

Begin at the bottom of the patch with the new shingles and use regular shingle nails for all the lower courses, but galvanized or copper nails for surface nailing at the top. Some surface nailing must be done in repair work.

Water often gets in around chimneys and walls because of rusty or defective flashings. The flashings are strips of tin, copper or other sheet metal which are laid against the brick and go under each shingle as it is placed. A penknife point pushed down on the flashing, especially if it is of painted tin, will often disclose that it has been nearly destroyed by rust.

**T**O MAKE a good repair, take up a narrow strip of shingles, put down new flashing, and replace the old shingles or put on new.

The flashings, if of tin, should be well painted on both sides and allowed to dry before being used. They should be about 6 by 8 in. and are bent and applied as shown in Fig. 1. One is placed under the end shingle of each course as it is laid, so that the flashings overlap each other. Except on the chimney or wall side, they are hidden from view when laid.

As shown in Fig. 1, the mortar is raked out from between the bricks where necessary and the counter flashing is turned in about  $\frac{3}{4}$  in. This metal is fastened in the joints with wall hooks or tenpenny nails and the cracks are filled with lead or elastic roofing cement.

Standard roofing cements alone will often make a serviceable repair over imperfect flashings at chimney or walls. They must be applied when the roof and walls are clean and dry.

We now come to what is the most difficult repair on a (Continued on page 117)



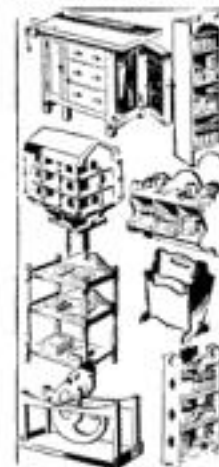
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## The Shipshape Home

### Repairing a Shingled Roof

(Continued from page 116)

roof—when a leak is found down the valleys. A valley is an angle or gutter formed by the meeting of two roof slopes and usually is laid with a continuous one-piece strip of painted tin or other sheet metal from top to bottom.

By pressing a sharp point against where shingles and flashing meet, you can tell if the metal has been eaten through. Remove and carefully store the shingles if they are sound enough to be replaced. In any case, keep one to show the angle cut. Note, too, just how they were originally laid. Have a tinsmith lay a new flashing down the valley. A chalk line then may be drawn from top to bottom as a guide in re-laying the shingles so that a workmanlike job may be done. This work requires some care and patience and should not be attempted before practicing on straight patches.

All other shingling repairs on roofs or walls can be accomplished by observing these suggestions and studying the method used in the old work that is to be replaced.

### Protecting Water Pipes

THE average house in localities where the winters are severe is "good business" for the plumber and an annoyance to the householder unless the water pipes are well protected from Jack Frost. Wherever water pipes are exposed to the extreme cold, freezing is inevitable.

My experience in having expensive repairs made during several winters led me to devise the following remedy, which cost less than a dollar for materials. I use it every winter and have yet to see it fail to safeguard the water pipes, although the outside temperature sometimes goes as low as twenty degrees below zero.

At the point where the pipes are likely to freeze, which in my house was usually at the water meter, I built a housing of sheet metal so as to inclose as much of the piping as possible. A small gas plate burner was placed under the pipes; a good oil lamp would have served the same purpose. The gas plate is turned on only enough to keep it burning, yet this is sufficient to hold the water at a temperature above the freezing point. On especially cold nights, as an additional precaution, the water is allowed to drip from one or two faucets, so that it will be kept in motion.—H. J. BLAKE, M.D.

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Before applying the molding, paint the outside surface and also the side that is to go against the glass.

On doors of other types, such as those having five panels, lay out pencil lines on the stiles and on the upper and lower rails as a guide for applying a rabbeted molding. Nail on the lower piece and one side, set the mirror in place and put on the other two strips.—EDWIN M. LOVE.

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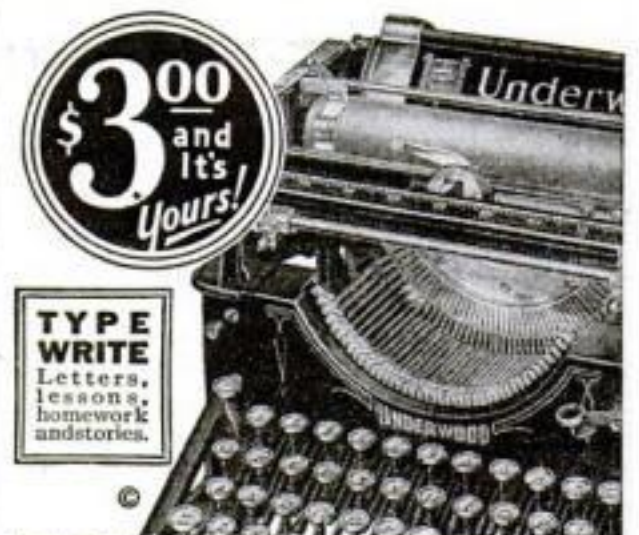
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## Better Shop Methods

Old  
Bill  
says—



GET the correct speed and feed and let the machine do the hard work while you do the head work.

Memory is a big asset to a man, but it is sometimes better to forget than to remember.

It is unnecessary to use back gears when turning or milling brass, copper and other soft metals, except perhaps for the removal of hard scale on brass castings; after the scale is removed, finish the job on open belt speeds.

Every man should try to give himself a square deal—and give the shop one, too!

If you were caught on the roof of a burning building, would you jump down or try to find a safer way? Then why jump to conclusions when you have a tough shop problem to solve?

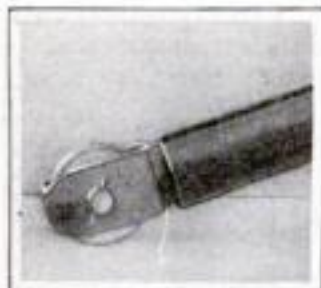
It is well to be sure that you are right, but it is not right to think that everybody else is wrong.

When filing work keep your file clean; if an ordinary file brush will not readily remove the small bits of metal that stick in the teeth, a piece of flat copper or brass will take them off.

Get down to business and get ahead of your luck.

There is no safe way to cover up or disguise a "bull"; lives are often endangered by faulty construction.

### Small Roller Makes It Easy to Move Long Pipes



End of the pipe with the roller inserted

It is for moving pipes about, especially in narrow aisles. It is merely an iron roller held in a sheet-iron frame. It is inserted in the end of the pipe, which is pushed along smoothly over the floor instead of being dragged.—NORMAN MOORE.

It often occurs that a piece of work is pulled off a demagnetizer and the current is left on unnoticed. This is harmful and costly. It can be avoided by installing a pilot warning light on the wall between the switch and the instrument.—H. J. C.



## Sign off to sweet dreams

You enjoy radio like a gentleman—if you can get the best out of your set and forget all worry and bother. That's your happy frame of mind when you keep your batteries full of pep with a Rectigon. The most absent-minded dial-twister snaps on a Rectigon without a qualm. What if you do tune in while you're still charging your battery? There's no harm done, not the slightest. What if the current does go wrong in the dead of night? Your batteries will not be discharged with a Rectigon attached.

when you keep power in your set with

## The Westinghouse Rectigon Battery Charger

©, 1926  
W.E.&M.Co.

### No Noise as It Charges

—not a bit of fuss. Not even a murmur that would disturb the mildest slumber.



### No Acids, No Chemicals

—no moving parts—nothing to spill or burn. No mess; no worry. You'll have no spoiled rugs, no ruined clothing.



### Saves Its Cost in Short Order

—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocket-book as well as your batteries.



### Snaps On in an Instant

—Just plug into the light socket, snap on the terminals. Saves service station bother. Spares interruptions caused by absent batteries.



### Charges Both "A" and "B" Batteries

—Keeps both packed with power. Bulb is used for "B" battery charging and is enclosed, like all other parts, in metal, safe from accident. (Rectigon charges automobile batteries, too.)



THE RECTIGON is a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

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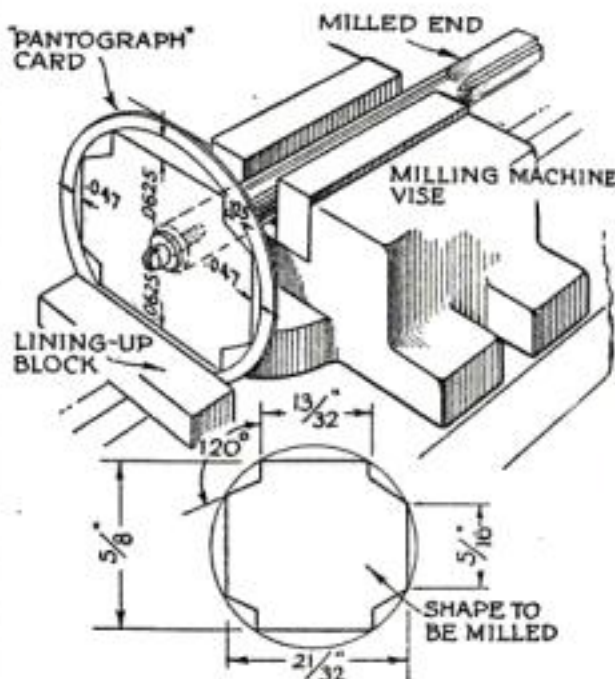
## Better Shop Methods

### "Pantograph" Card Aids in Milling

By HENRY SIMON

MILLING a rod to an odd cross section, such as shown below, is not so hard when the proper equipment is at hand to do it with, but presents great difficulties when, as is more often the case, it must be done on a plain miller with only an ordinary vise. To hold several surfaces parallel or at specified angles to each other while staying, at the same time, within specified dimensions, is extremely hard. That is because there is no good way of checking accurately the position of the surfaces as the work progresses.

A satisfactory method of solving this problem is to use a modified pantograph method. On a disk of stiff bristol board, the cross section is drawn carefully on a large scale, say ten to one. The disk is fastened directly to the end of the rod to

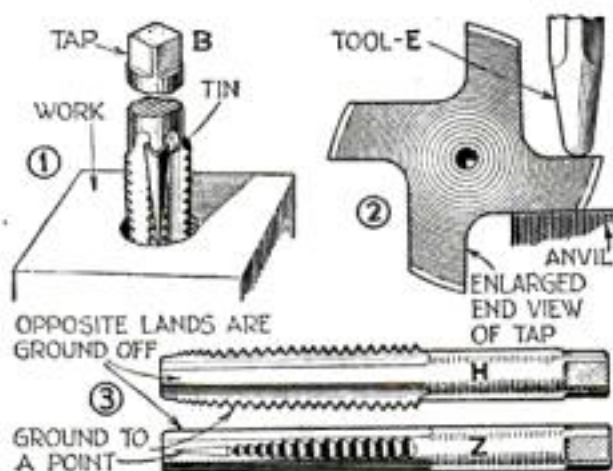




## Better Shop Methods

### Kinks That Have Helped Me in Tapping Jobs

SOMETIMES a hole, tapped with a worn tap, is too small. A trick useful in such an emergency is to slip a cut piece of tin over one land of the tap B as shown in Fig. 1 and re-tap the hole. Another method of making a tap cut larger is to anneal the tap and swedge or upset it just under the teeth with the tool E, Fig 2. This method sometimes is used to give a



Emergency measures for making a worn tap cut large; an improvised left-hand tap

tap clearance. The tap should be re-hardened and tempered.

In Fig. 3 is shown a treatment that makes possible the tapping of a left-hand thread with a right-hand tap. Two of the lands are ground flat, as at H; the other two are ground very thin, especially the entering teeth, as at Z. By careful manipulation the tap will cut an acceptable left-hand thread when there is no time to make a proper tap.—CHARLES KUGLER.

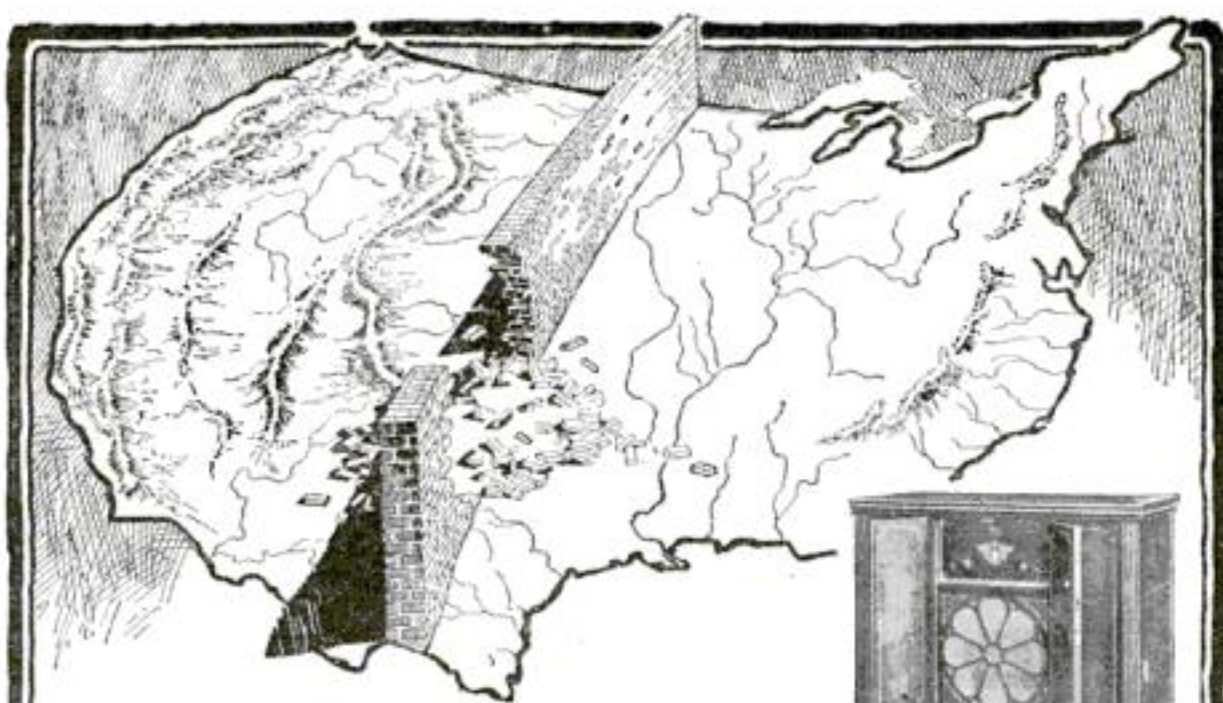
### "Pantograph" Card for Milling

(Continued from page 120)

projection on the machine bed where it can be made to register both the vertical and transverse movements of the table. As an aid in this work, the differences representing the required number of thousands of each cut from the periphery of the work to the finished surface are marked on the pantograph drawing as shown. If this is done, the work can be milled rapidly to within close limits both as to angles and dimensions.

One necessary condition is, of course, that there be enough of a true surface on the work to take hold of it again evenly each time it is reset, although it is not necessary that it always be a rod, as in the illustration. Work of a general square, hexagon or other polygonal cross section can be handled, provided only it be long enough. This is accomplished by casting a babbitt sleeve around the portion to be held in the vise, and turning it on centers, if the work cannot otherwise be safely clamped. Such a case is where angles on the milled part must be at odd angles to the surfaces of the piece.

Work varying in length from a few inches to several feet can be handled in this manner. For very long work an additional support should be clamped to the miller table near the disk.



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*Remote stations come in with remarkable clarity and volume even when local stations are on.*

FEW commercial sets made have such power—or power so easily and simply controlled.

All the RADIO experience of 14 years is back of this new Priess, the best set that our radio engineers have ever made and wonderful value for your money.

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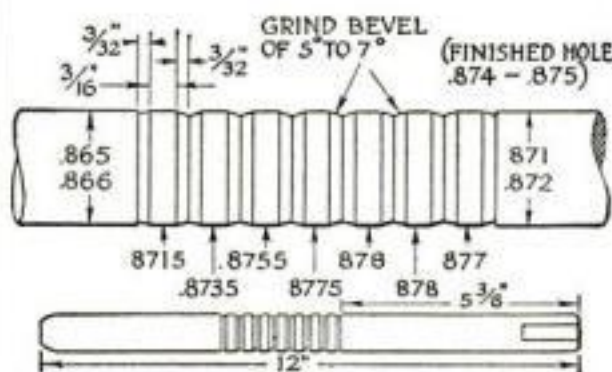
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## Better Shop Methods

### Burnishing Broach for Bronze Bushings

LARGE manufacturers recognize the merits of the burnishing broach for finishing holes. It is a tool that deserves a place in the jobbing or repair shop. The mirrorlike finish it leaves is of superior quality; the cost of the tool is less than that of the corresponding reamer, and the time for finishing is reduced.

The tool is similar to a cutting broach except that the teeth are smooth and usually closer together, as there are no chips. The finish of the teeth must be the best attainable. The illustration shows a design that was successfully used to finish front axle bushings after assem-



A tool used for finishing axle bushings. Note the dimensions of the various teeth

bly. The broach is forced through the work with an arbor press.

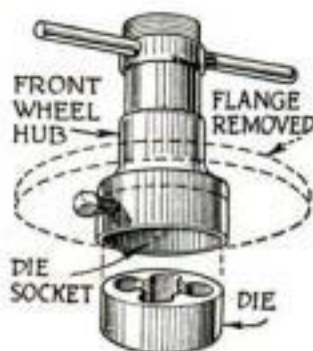
The entering end of the broach is enough smaller than the hole to go in the un-sized bushing. From the entering end the lands increase progressively in size to the last three teeth. Then two are the same size, and the last is slightly smaller.

It will be noticed that the drawing calls for final teeth larger than the finished hole should be. This is because the metal of the bushing will "come back" to some extent after the broach has been forced through it, and also to permit the last teeth to be stoned down to make the hole fit the gage. Were the teeth to be made the exact size at first, the hole might be too small and the broach could not be enlarged.

The tool is made either of carbon or high speed steel. It is rough-turned, hardened and ground to size. Then it is lapped to final dimensions by working the lap back and forth over the teeth. Tallow or grease may be used as a lubricant with it, if desired.—H. L. WHEELER.

### An Extension Die Holder

IN A shop doing general work a die holder was required in a hurry to thread some auto spring clips. An imaginative mechanic rescued a Ford front wheel hub from the scrap pile, cut the flange off, and put in a set screw and a handle. This just fitted the dies used.  
—G. D. HUGO.



Die holder made from an old auto wheel hub

## Big 3-ft. Telescope

Makes people and objects miles away seem close. Brings new pleasures to home, farm, camp, travel, sport. See moon and stars as never before. New Ferry "Wonder" telescope has 5 sections—over 3 ft. long open, 12 in. closed. Fully brass bound. Powerful lenses.

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With Every Telescope! Handsome leatherette covered Carrying Case, light, strong, complete with strap. Handy for farmers, auto tourists and hikers.

5 Sections 8-Power Lenses Thousands Delighted!

"I am delighted with the 'Wonder' telescope. Today I have been watching submarines 3 miles off the coast."—Philip Brush. "I can see across the Mississippi 3 miles and see people fishing."—M. L. Thorn. "I am nearly 80 years old and if I could not get another would not take \$10.00 for it."—A. R. Walker. "I can tell time on the church clock 5 miles away."—Edward Foster. "Could tell color of aeroplane 4 miles away."—Mrs. L. M. Yarbrough. "I saw a Light House 13 miles away."—Clyde Scribner.

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Send name and address and Ferry Wonder 3-ft. Telescope with free Carrying Case will come by return mail. Pay postman special bargain price of \$1.85 plus few cents postage. Satisfaction guaranteed or your money back. Supply limited, order today!

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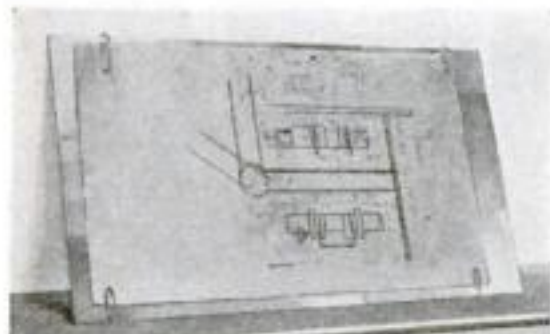
Tires hammered full of nails, leak no air. Amazing new invention banishes puncture trouble forever. Punctures heal instantly while driving. Stops slow leaks. Preserves rubber. Increases tire life. Clean—scientifically correct. Agents—up to \$85 a week Immediate—tremendous profits. No talking—just drive nails in an old tire. Schulte, cleared \$19.00 in an hour—Willeox, \$60.00 first day. Get the facts. Territory going fast. Full particulars and FREE sample offer by return mail. ACT NOW. C.F. JOHNSON & CO., 10 W. Jackson Blvd., Dept. 414, Chicago

Read Interesting article on Page 4. "How \$100 a Month, Invested Properly, Can Make You Independent."



## Better Shop Methods

### Tin Sketch Board for Rough Use in Shop



The drawing paper is fastened with wire paper clips to a scrap sheet of heavy tin

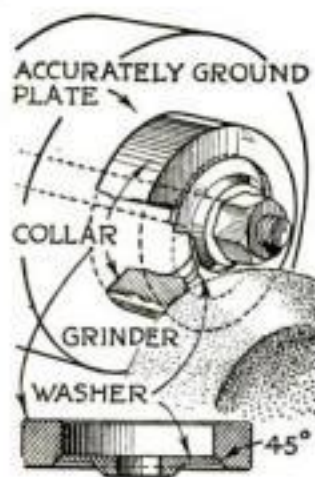
A MOST practical sketch board for rough shop use is a piece of smooth, bright, heavy tin. The paper is held firmly in place with four common wire paper clips. The tin and clips are easy to obtain. The expense is trifling compared to the finishing of a wooden board.

The writer has done shop sketching and drawing for a number of years, and is willing to match this "board" with anything for simplicity, durability, and practicality.—FRANK BENTLEY.

### Beveled Washer Is Help in Grinding Collars Parallel

GRINDING milling machine collars accurately parallel often is not the easy task it seems. To handle this work efficiently the writer devised a method that is giving exceptionally good results.

One face of the collar is ground at the same setting with the hole. A bevel is ground on the opposite side of the collar to take a washer made as shown in the accompanying illustration. The collar is clamped with its finished side against an accurately ground plate by means of a rod through the spindle.

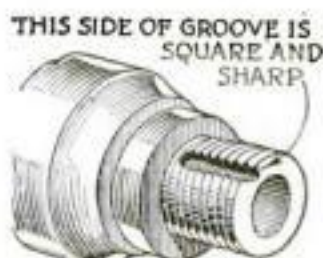


Collar in position for grinding second face

The second face of the collar then is ground with a cup or saucer wheel.—O. S. MARSHALL.

### Dust Groove Protects Threads on Spindle of Lathe

DIRT, chips and dust will collect in the internal threads of faceplates and chucks so that when they are screwed on the spindle nose, some wear and cutting occurs. To prevent this, a groove may be filed into the spindle as shown.—F.N.C.



Dust and chips are collected in the groove

# Announcing the new Prest-O-Lite Trikl-Automatic Radio "A" Power Unit

AN "A" power unit combining Prest-O-Lite's fine storage battery with a trickle charger. A unit that can be plugged into an electric light socket, then hooked up to the radio set—and forgotten! It charges itself automatically.

It's new. Entirely automatic in action. No switches to operate by hand. Now you can have full storage-battery power for your radio all the time. Power that is noiseless and without the slightest pulsation, the kind of power that brings in the distant stations loud and clear.

Never again will you have to bother with a charger. Never again will a run-down "A" battery spoil your radio.

The unit is beautifully finished in deep maroon. Small and compact.

You'll find further details below. But the main thing is to see it. Go to the Prest-O-Lite dealer's store. There's one near you. Or write us and we will give you a lot of interesting facts about this wonderful new "A" power unit.

And remember, it is made by a company which has had more than twenty years of manufacturing experience.

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The charger. Built on an entirely new principle. Silent in operation. Adjustable to needs of individual user. Economical to operate. Nothing to get out of order. Nothing to replace. Built to last for years.

No moving parts. No bulbs. No electrolyte. No water or acid to be added. No electrodes to wear out. Entirely automatic. No switches to operate by hand. Built-in power relay automatically shuts off the charger when radio is in use and turns it on again when radio is idle. Will operate at any distance from set.

Fully enclosed. Entire unit enclosed in beautiful metal case, with hinged cover and handle.

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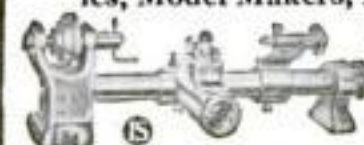
who want a real, accurate machine tool at a price within easy reach. A complete shop in itself. Capacity 4 in. diameter x 12 in. length. Handles metal, wood and other materials. Turning, facing, boring, drilling, winding, thread cutting. The "Wa-de" is a bargain at several times the price. Guaranteed a high degree of accuracy, quality of materials, workmanship and finish.

The slider rest has travel entire length of bed. Lead screw inside bed. Hollow spindle.

No. 1 Lathe, plain headstock - \$28.00  
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So overwhelming has been this response that in the first 60 days following its introduction home owners, large and small, invested \$3,127,461 in this new NOKOL—a phenomenal sales record.

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And remember this: For periods up to nine years NOKOL has proved to be the lowest-cost full automatic oil heat known. In fact, it costs no more than hard coal, usually less.

You will want to learn more about the new Silent NOKOL and our convenient budget plan. Mail the coupon today for full particulars—and our valuable new guide on oil heat for homes.

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City ..... State .....

## Better Shop Methods

### How to Fit Machine Keys

(Continued from page 72)

After the key has been fitted perfectly, smear a little oil on its faces before driving it home; you'll be thankful if you yourself happen to be the one to remove it later on.

Woodruff keys are much used by machine-tool builders and automobile manufacturers. They should fit reasonably tight on their sides with a minimum of clearance top and bottom. The keyways for this type of key are milled with special cutters for each size of key. The standard depth of the cut is gaged by the diameter of the shank; in other words, the cutter is sunk in until the shank just touches the shaft.

THESE keys are usually made of cold rolled steel and require very little fitting. They are sometimes sweated into their seats to make a very solid job. This is done by tinning the key, heating the shaft slightly in the region of the key seat, and placing the key in its seat. To tin the key it must be polished all over. Dip it first in the acid, then in melted solder, and allow it to cool. The shaft may be heated with a blowtorch or any other convenient means, preferably in a gas or oil furnace as a coal fire is apt to leave a deposit in the keyway.

When fitting any kind of a key it is important to keep the corners well rounded and the ends beveled, and be certain that the bearing is on the flat surfaces and not on the corners. The beveled ends prevent the key from upsetting while it is being driven and also make it easier to remove. If a key bears the least bit on any of its corners it may cause a false bearing, in which event it will loosen up quickly in service. In driving a key home it is best to use a "set" or block between the key and the hammer. Direct blows from a heavy hammer may cause the key to swell and stick hard in its seat so that removal will be extremely difficult.

KEYS are often stubborn things to extract and it is sometimes necessary to resort to heating or drilling. A badly stuck key may be dealt with by heat and hammering and the liberal use of kerosene. A good hot torch flame played over the outer surface of the keyway often will help. Kerosene should be squirted into any small crevice with an oiler to dissolve the rust. Peening with a ball peen hammer directly over the key-seat also will help to start an obstinate key.

Key drivers can be made out of good chisel steel, drawing the body out into a long, rectangular-shaped punch and tempering it about the same as a cold chisel. The tools should fit loosely in the keyways and be ground off perfectly square on their fore ends. Small sizes can be made out of drill rods. Pinch bars and wrecking bars, wedges and taper chisels also are useful in removing keys that resist ordinary efforts to remove them.

When a gib (Continued on page 125)



Keeps out drafts, rain, snow, heat

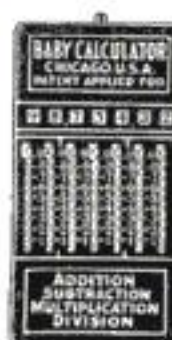
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## ZIP-ZIP

Here is a letter we received from a lady from way out west.

Gentlemen:  
My boys were so delighted with the Zip-Zip shoes that they ordered from you that I am enclosing check for one dozen more. I want each of their friends to have one also. Please send these as soon as possible.

Thousands of boys are made happy with this wonderful Zip-Zip shoe. Order from us or your dealer. 50c each or \$5 for \$1.00. Send stamps, coin or money order.

AUTOMATIC RUBBER CO., Dept. 22, COLUMBIA, S. C.



## Better Shop Methods

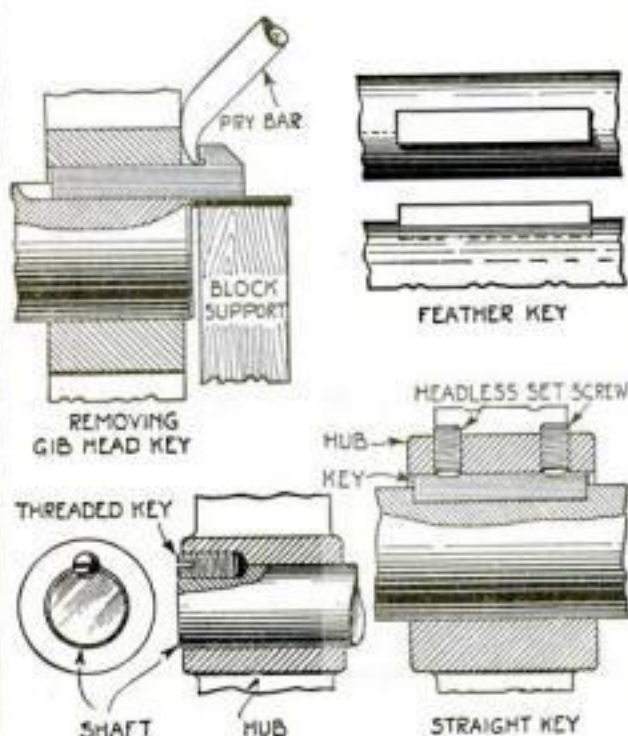
### How to Fit Machine Keys

(Continued from page 124)

key is used on the end of a shaft, as in the case of a flywheel, the projecting head should be covered with a hub cap to prevent accidents. In prying out such a key, it is well to support it on the under side with a jack or block of wood. That prevents the key from bending under the strain of the lever.

The last resort, if a key resists all other ways of removal, is to drill and tap a hole in the end for a bolt or stud. The bolt will serve as a jack in conjunction with a strap and block placed against the shaft or hub. By tightening the nut and hammering lightly against the bolt at the same time, the key ordinarily will respond.

A hole may be drilled the whole length of the key, if necessary. This weakens its hold. By tapping part way in for a bolt or stud, the key generally can be removed;



Removing a gib key; straight and feather keys; a threaded key for experimental work

it also can be crushed sideways toward the center with a cape chisel. A pull on the bolt or stud is then generally sufficient to withdraw it.

Often when repairing or overhauling machinery away from the home shop, keys will stick in spite of all one can do. A square key sometimes can be removed, if a driver is not available, by using a pair of nail pincers, the sharp jaws of which are closed into nicks made in the side of the key with a sharp cold chisel.

A key sometimes used in light experimental work is the threaded screw pictured in the illustration above. This not only acts as a key but also holds the gear or pulley in a registered position on the shaft. After the machine has been taken apart for repairs or to make changes, a gear so keyed always can be restored to exactly the same lateral position, as the threads must line up before the key can be inserted.

Fitting keys brings to mind the actual case of Tony, a new machinist in my old shop. Machinists were scarce at the time, and although Old Bill, the foreman, had his (Continued on page 126)



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with a World Wide Reputation*

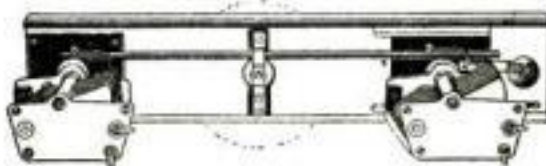
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## Pressure-Gauge for "Steamy" Production

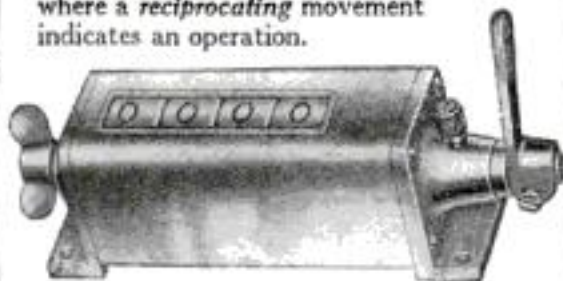
How hard is your machine being pushed for higher production? — a Counter will tell.

How effectively is development-work being pushed on a new machine? A Counter will tell.

If you want more pressure behind production or more "push" behind developments, fix it so the extra effort *must* register on a

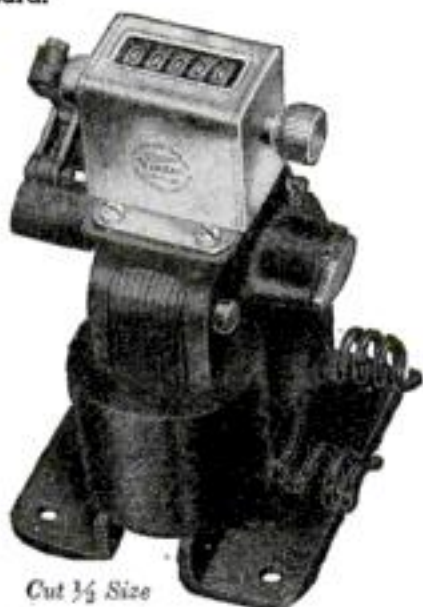
*Veeder*

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50 subject to discount. (Cut less than 1/2 size.) Set Back Revolution Counter of similar model, \$10.00 (list).

The "Form UM" Magnetic Counter below counts operations or units of output, from any distance that wires connect with machines. Can be placed over desk or on convenient Counter-Board.



Cut 1/2 Size

Mechanical contacts on your machine make and break the electrical circuit which operates the counter. The electro-magnetic drive can get its current from your regular lighting circuit (110 volts), or from storage battery.

Write us about that counting problem of yours—or write for the counter catalogue.

**The Veeder Mfg. Co.**  
44 Sargeant St., Hartford, Conn.

## Better Shop Methods

### How to Fit Machine Keys

(Continued from page 125)

doubts as to Tony's ability, he nevertheless gave him a chance to make good and put him to work fitting keys on a big machinery job. Tony worked half a day unobserved, but after the lunch hour Old Bill gave him the once over from behind a big casting.

The key upon which Tony was then working had been made undersize and the gear did not tighten up when slipped on to the key. Slyly taking his pocket-knife, he cut several paper shims from a newspaper to place under the loose key. Old Bill then descended upon him and headed him abruptly for the paymaster's window.

"**T**HINK about six inches ahead of your work," was the advice given us young fellows one day years ago by Old Bill. He, strange to say, really practiced what he preached. Here is how he applied it to his work when fitting machine keys:

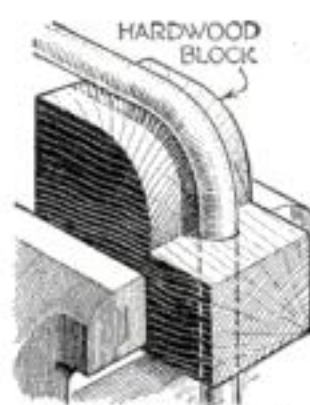
He cut off a piece of stock to make a key a few inches longer than necessary. A cut or two over one side in the shaper brought the key to the approximate size, with the necessary taper of 1/8 in. to a foot. Slipping it into the keyway until it bottomed, Old Bill had his cue mark for cutting off the projecting ends. And while other mechanics were taking fine cuts and filing their heads off to make a fit and trying their best not to get their keys undersize, Bill just loafed along, never appearing to hurry, and yet beat them every time. Compare his method, which involved only the loss of a few ounces of steel, with the time consuming fit-and-try efforts of less skilful machinists.

"Lock your power grip with a key well fitted and be proud of your job," is a motto often quoted by Old Bill, who knows how to fit keys properly.

If you are a regular reader of this department, you are familiar with the exploits of the machine shop foreman known as "Old Bill." Joe V. Romig, who wrote this article on keys, was one of many fine machinists who learned their trade under Old Bill's kindly guidance. The article, it might be added, has just come to light among some old papers; it was written by Mr. Romig in 1922 shortly before his death and represents his last work for POPULAR SCIENCE MONTHLY.

### Block for Bending Tubing

**G**ARAGE men and others who have to bend brass or copper tubing will find the block shown an aid in turning out good-looking work. The hole is about 1/16 in. larger than the tube. The block can be held in a vise, or by hand.—H. L. W.



Makes neat bends

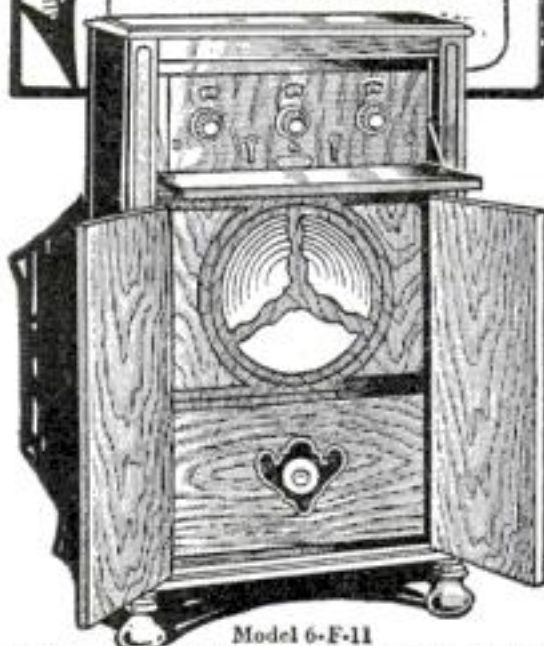
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You can easily make a highly sensitive microphone by using this Transmitter Button to collect the sound waves. You can build your own outfit without buying expensive equipment. It is simple and inexpensive. You can install an outfit in your home and hear conversations being held all over the house. You can connect up different rooms of a hotel. This outfit was used by secret service operatives during the war. It is being used on the stage. It is ultra-sensitive and is the greatest invention in microphones. You can mount the button almost anywhere—on a door knob, stove pipe, stiff collar, on the wall behind a picture frame, etc. Button is so light and small it cannot be detected. Persons can be overheard without suspecting it. You can listen to conversations in another room. A dead person in the audience can hear the speaker. Connected to phonograph, piano or other musical instrument, music can be heard hundreds of feet away. Buttons may be used to receive telephone transmissions often makes an old line "talk-up" when nothing else will. The ideal microphone for radio use; carries heavy current and is extremely sensitive. Amplitude signals. Countless other similar experiments along the lines of telephones, amplifiers, loud speakers, etc. Many facilities stand to be devised, such as holding the button against the throat or chest to reproduce speech without sound waves. \$3.00 is given to anyone who sends in a new suggestion for the use of the button providing the manufacturer find it suitable for use in their literature. PRICE \$1.00 POSTPAID ANYWHERE.

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## BOYS! BOYS! BOYS!

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With the Fire Eater in his possession any person can become a perfect salamander, apparently breathing fire and ejecting thousands of brilliant sparks from his mouth, to the horror and consternation of all beholders. Harmless fun for all times, seasons and places. If you wish to produce a decided sensation in your neighborhood don't fail to procure one. We send the Fire Eater with all the materials, in a handsome box, the cover of which is highly ornamented with illustrations in various colors. Price of all complete only 30 cents, postpaid.

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## Better Shop Methods

### Repeating Odd Shapes on a Shop Drawing

THE accurate repetition of an odd or irregular shape in a drawing, if required many times, is frequently a difficult and tiresome job. In isometric work, the re-drawing in accurate alignment of the same ellipse representing the section of a shaft or a hole, often among a maze of other lines, is one of those things that take the joy out of life. That is especially true when the work is small. The many construction lines run close together through other permanent and temporary lines and are interspersed with dozens of pinholes made by the compass.

All these troubles can be avoided by means of the simple method illustrated. It consists in making a templet from paper-thin celluloid and using it stretched over the hole in one of the regular triangles. Blank camera film is just right for this purpose and can usually be had for nothing.

A drawing of the required shape is first made somewhere on the board, and the piece of film tacked over it. Next, necessary center lines are drawn on the film so that they will be plainly visible when the templet is finished.

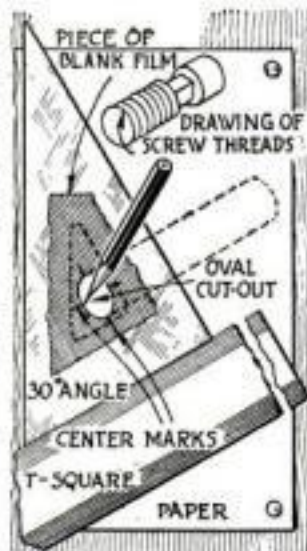
The drawing is scored on the film with dividers or knife, depending upon its character. An ellipse such as that shown in the drawing, for instance, is best made with a bow divider, and it is preferable to go over each arc several times instead of trying to score the full depth at one cut. Other shapes can be made with a knife and French curve, and in that case a single cut will be enough.

When the scoring is done, it will be found that by bending the film, the core can be broken out clean. The border of celluloid is trimmed to leave about  $\frac{1}{2}$  in. margin for overlapping on at least two sides of the hole in the triangle on which it is to be used. It is stuck on with a couple of daubs of library paste.

When the job is done, the templet can be pulled off and preserved for future use. After a number of such templets have been made, the draftsman often will find that he can use one of these for some new job he has to do.

Screw threads, coil springs, multiple disks or annular grooves and similar work in isometric drawings are a few out of many instances where templets of this kind can be used.—H. S.

Worn oilstones and razor hones can be lapped straight with emery and water on a flat iron plate.



Drawing ovals with a celluloid templet

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## "Cave-In"

(Continued from page 11)

comrades, crushed beyond recognition.

All through that night, and the next day, the first efforts of those above to penetrate downward through the shaft seemed all but hopeless. Death lurked at every step; for now and again a loosened boulder fell and roared into the inky blackness. The lowest depth to which the rescuers could penetrate was the second level, about 200 feet. Between them and the imprisoned men there remained nearly 600 feet of debris. They knew they must sink a new shaft, rebuilding the shattered walls, a foot at a time, from the top down. And so, while some of the rescuers dug into the debris, others were busy rebuilding the cribbing with planks, posts and steel girders.

These were the "front line" men. Supporting them from the rear was a force of men and materials concentrated at the top of the shaft. Here were stacked great piles of lumber and steel for the bulwarks. Here crews of timbermen cut huge mine timbers to the proper size and shape. Other crews of welders burned steel girders to size and bored bolt holes by which the girders could be fitted in place below.

NOW and again there emerged daring heroes who, in the desperation of struggle, gambled their lives in attempts to explore the black hole. Alfred Maki was one. During the first hours of rescue he risked being crushed to death by boulders in a vain effort to climb upward from the bottom of the shaft. On the second day, he was lowered from the top. But his powerful light could not pierce the gloom of the abyss below.

Another miner, John Matala, made the attempt. Three minutes after his return to the surface, a cave-in dropped tons of earth into the shaft where he had been.

The second point of attack—that of drilling a narrow communication hole 412 feet deep straight downward from the second level—offered little more hope of immediate success. Three precious days passed before the drilling could be started; for it was necessary first to dig a tunnel twenty-seven feet upward from the second level to enable experts to install a diamond drill.

This drill consisted of a short piece of pipe, in one end of which were set five diamonds, as in a diamond ring. The drill was screwed into a longer length of pipe and revolved by compressed air. Biting through the earth at the rate of about three feet an hour, it had gone down about a quarter of the distance toward the goal at the time of the rescue.

THE third onslaught, directed diagonally upward from the thirteenth level of the neighboring Aurora shaft, seemed to offer the best hope of success. Here a rescue crew of sixteen men, working in four-hour shifts, toiled ceaselessly with their drills to open a narrow way into the dungeon above. When the rescue came they had gone more than halfway. They had dug 280 feet, with about 200 feet still to go.

All this time. (Continued on page 130)

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## "Cave-In"

(Continued from page 129)

near the bottom of the wrecked "G" shaft. Hawes, Olson and Erickson were pinning their faith on the plan of boring and climbing upward. In the beginning, Hawes had suggested this plan, after he had studied a chart of the Pabst mine.

"It could be done," others had agreed, "but you'd still be a thousand feet below them; they're on the eighth level."

"The fallen rock isn't packed tight in the shaft," Hawes had replied. "Cut a hole big enough for me to crawl through to a level where the shaft is open, and I'll find a way to climb up through the shaft from level to level."

**T**HAT was on Saturday. Erickson took charge of driving the vertical tunnels up from the twenty-fourth level. It was extremely difficult. The passage was made about three feet in diameter. Only one man could work in it at a time, and he was compelled constantly to brace the shaft as he progressed, to prevent a cave-in. At intervals, as they bored from level to level, the rescuers tapped the main shaft to learn whether or not they had passed beyond the obstruction. At the twenty-first level it was still blocked; but beyond the twentieth it was clear.

It was then that Hawes made good his promise to "find a way to climb up through the shaft," and was finally rewarded by grasping the big hand of Tom Trewartha and receiving the joyous greeting of his men.

During the days of imprisonment, Trewartha had proved that he, too, was a safety expert, trained in the science of rescue. After the cave-in he had led his men to the task of bracing the entrance to the eighth level with steel rails and timbers, to guard against further cave-ins. Then, gathering his men about him, he laid plans for escape. By this time the three "road monkeys" stranded in the thirteenth and eighteenth levels had climbed up the shaft ladders to join the others.

**O**DDLY enough, Trewartha's schemes of escape coincided almost exactly with the expedients devised by the rescuers, and he and his men attempted every one of them. First, volunteers tried climbing down the shaft, then up. There was no way out. Then they tried to break through to the abandoned "C" shaft. Finally they attempted to dig a tunnel through to the Aurora mine, little dreaming that rescuers were digging toward them from the other end.

For the final act in the rescue, everything had been prepared by experts hours in advance—food, hot drinks, warm blankets, doctors, nurses. At the bottom of "H" shaft elevators were waiting to carry the men to the surface. And above, on a siding close to the pithead, stood one of Uncle Sam's mine rescue cars with complete first-aid equipment. It had been rushed to the scene from a town in Wisconsin.

So, by the methods of science, the lives of forty-three miners were miraculously saved.

## Ship Model Plans



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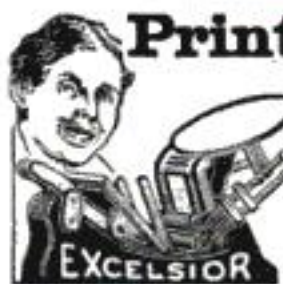
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Advice for Popular Science readers regarding safe and profitable investments. See page 4.

## Your Feet and Shoes

(Continued from page 18)

have a short Achilles tendon, so that, for her, the proper shoe had a heel of more than medium height. In her case the low heel merely made additional trouble.

Style and the construction needed to remedy unusual foot conditions cannot always be combined. And when confronted with a choice between painful feet and a specially made corrective shoe, most women prefer the pain.

One day the wife of a department store manager entered the salesroom of a corrective shoe company. Her feet had been giving her extreme pain. She had come, under protest, only on the orders of a foot specialist. She was twenty-eight years old, modishly dressed, and more than ordinarily attractive. The shoe manufacturers gave particular attention to her needs. She was on the verge of serious foot trouble. They selected for her a firm, rather round-toed shoe that looked like the ordinary well-made walking shoe in all respects except one—it had an unusually long, low heel. It was that unusual heel that aroused the lady's most strenuous objections. She burst into tears and refused to wear it.

**B**UT three days later she was back—with her husband. The husband-manager was a little set around the jaw. His wife put on the shoes. She admitted they made her feet feel better. She wore them out of the store. And the end of the story? For several months the lady wore those detestable shoes. Her feet got better. As soon as the pain was gone she threw the shoes away—and went back to wearing regularly the styles that had made the trouble in the first place.

Though an arch support gives relief, it does not in itself effect a cure. In the military service, arch supports are not permitted. The cure for fallen arches is to build up again the strength and elasticity of the muscles in the sole of the foot.

After about three months of wearing proper shoes, foot experts tell me, feet should be re-fitted. This is because the muscles get a chance to develop after being given plenty of room. The second fitting will usually last indefinitely. Permanent improvement comes slowly. The wearing out of at least one pair of properly fitted shoes ordinarily has to come first.

**N**EXT in importance to wearing the right shoes is proper walking. Don't toe out! Toe straight ahead, or even (if you have fallen arches) slightly in. Avoid undue strain or long walks on hard pavements. One physician suggests that people unable to get away from city pavements try walking frequently along the cracks in the sidewalk, putting one foot directly in front of the other. This necessitates a certain amount of balancing that tends to strengthen the muscles in the foot, and, in addition, throws the weight to the outer edge of the foot.

Next, almost as important as proper walking, comes proper resting.

A good rest is the first step in starting remedial treatment; this an arch support may give. Weak (Continued on page 132)



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 No garage bills!  
 No traffic delays!

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*Noah Beery*

Noah Beery, the swashbuckling Sergeant in Famous Players' "Beau Geste," and other feature films, knows from personal experience that the fellow who gets ahead is the one who can do things. That's why he is giving his own son (pictured here with Wally Reid's boy) a saxophone for Christmas—starting him right on the road to pleasure and popularity.

What accomplishment have you? Do you play the saxophone? No matter what your age we can teach you quickly, easily. Why envy the other fellow his good times, popularity, leisure, extra spending money, when you can enjoy the same things, too?

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## Your Feet and Shoes

(Continued from page 131)

feet can be helped by being given every available opportunity for relaxation. A good position is to sit with the feet crossed, resting on the outer edges of the shoes. This allows free circulation, full relaxation, and a complete change from the walking position. It's not particularly elegant, but it's comfortable and healthy. And at least it means you look at ease, like a camp stool.

Finally, proper exercises and care of the feet are necessary. Two or three minutes a day devoted to foot exercises just before going to bed will usually accomplish wonders. Move the feet about in every direction; wiggle the toes. Try to pick up marbles with your feet. Walk along a line in the carpet, throwing the weight on the outer edges of the bare feet.

Nails should be cut straight across instead of round, as finger nails are.

**C**OLD water tones up weak feet. One mistake that many people make is to put aching feet in hot water. That tends to weaken the muscles and ligaments, though it may give temporary relief from pain. The proper treatment is the exact opposite. Just before going to bed put the feet, for a few moments, in cold water. That tightens them up, strengthens and revitalizes them. A brisk rub will quickly bring them back to warmth. Alternating hot and cold water, changing quickly from one to the other without giving the feet a chance to soak, also frequently gives good results.

Massage helps weak feet by stimulating the blood circulation that builds up the muscles. Such feet should be kneaded and rubbed with the hands night and morning.

## "It's Brains Against Brains —Fighting Gorillas!"

(Continued from page 13)

a booming, echoing noise like a big drum. "The cracking of the underbrush told me that the whole band was after us. Hearing them, the young gorillas we had caught began to squeal, just as I was assembling my motion picture camera in the hope of getting a sensational strip of film. We were in the clearing, and I didn't expect the gorillas to come out from the cover of the trees, but hoped they would come near enough to the edge of the woods to enable the camera to picture them.

"Gorillas think much like humans; they weigh their chances and do not plunge headlong into danger, as do the elephant, lion, rhino and buffalo. Against a showing of superior force they usually take it out in roaring, unless enraged to the point of uncontrolled ferocity when their young or family is threatened. And, I suppose, they give humans credit for being as strong as they are, the two races, man and gorilla, resembling each other in so many other ways. Otherwise they would never hesitate to attack man, I am sure.

"I had three (Continued on page 133)

Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912 of Popular Science Monthly, published monthly at New York, N. Y., for Oct. 1, 1926, State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 411, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Popular Science Publishing Co., Inc., 250 Fourth Avenue, New York, N. Y.; Editor, Sumner N. Blossom, 250 Fourth Avenue, New York, N. Y.; Managing Editor, Raymond J. Brown, 250 Fourth Avenue, New York, N. Y.; Business Manager, O. B. Capen, 250 Fourth Avenue, New York, N. Y. 2. That the owners are: Popular Science Publishing Company, Inc., 250 Fourth Avenue, New York, N. Y.; Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 250 Fourth Avenue, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; L. B. Tunison, 6 N. Michigan Ave., Chicago, Ill.; A. L. Cole, 250 Fourth Avenue, New York, N. Y.; Godfrey Hammond, 250 Fourth Avenue, New York, N. Y.; Sumner N. Blossom, 250 Fourth Ave., New York, N. Y.; John Nichols, 250 Fourth Ave., New York, N. Y. 3. That the known bondholders, mortgagees and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. Capen, Business Manager.

Sworn to and subscribed before me this 30th day of Sept., 1926.  
Bertha Strauss, Notary Public, New York County.  
New York County Clerk's No. 519, New York County  
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(Seal) My Commission expires March 30, 1927.

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## "It's Brains Against Brains —Fighting Gorillas!"

(Continued from page 132)

natives with me this time. To one, the gun bearer, I turned over the crank of the camera with instructions to keep turning until I told him to stop. Flanked by the other two, each carrying a squirming gorilla infant, I advanced toward the place where the shaking of the shrubbery and the roaring of the beasts told me the band was assembled.

"They kept up a continuous thunder of drumbeats as we approached, but I couldn't see a single gorilla through the dense underbrush. The racket finally became so threatening that my two natives bolted with the captives. And that, it seemed, was what the 'old man' gorilla had been waiting for. I was alone.

"HE CRASHED toward me through the underbrush, a huge, hairy, towering bulk, walking erect, almost like a man, with his great arms hanging to his knees. No wonder the unarmed natives fear the gorilla. But that was an afterthought. "I fired once. He was so close that I could not miss. He fell dead, almost at my feet, and the rest of his family fled into the forest.

"As he lay there, in the crater of the ancient volcano of Mikenno, I measured him. Six feet tall he had stood in life. His foot was twelve inches long; his fist when closed would have filled a gallon measure. I estimated his weight at 450 pounds, and do not think that is exaggerated. His muscles stood out in great knots, indicating his tremendous strength.

"He seemed so human, like some prehistoric ancestor of our own race, that if I had gone into the gorilla country for the sport of killing them I believe I would have abandoned my expedition then and there. But I was on a scientific mission this time, and the skin and skull of that monster are now being mounted in the National Museum at Washington, the only specimen of the full grown Kivu gorilla possessed by any museum."

While he was talking, I had noticed that Mr. Burbridge rubbed his left hand frequently. Now he caught my glance and held his hand toward me, so that I could see the scars upon it.

"THOSE are mementoes of one of the most exciting experiences I ever had with a gorilla," he explained. "I determined to try to get at least one live gorilla larger than the babies which had previously been the only ones captured. The one I picked was a male, perhaps seven or eight years old and weighing one hundred and twenty-six pounds.

"I got him, the largest gorilla ever taken alive. But after the battle a survey of the field showed two fingers broken on my left hand, the left thumb mangled, both hands lacerated where he had used his teeth, and half a dozen of my natives lying around, mauled and bitten. The underbrush had been trampled flat in the struggle. A bloody trail led off into the forest, left by another gorilla who had tried to interfere but had been shot by my (Continued on page 143)

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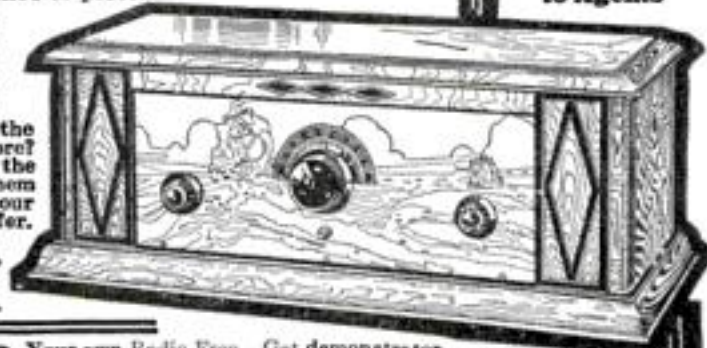
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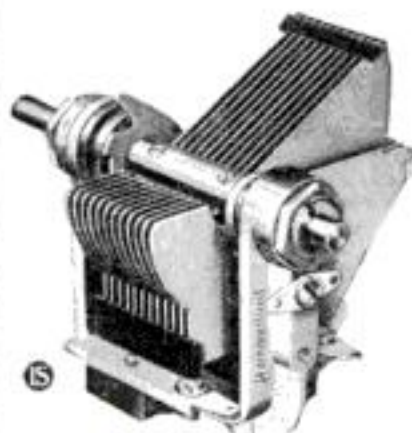
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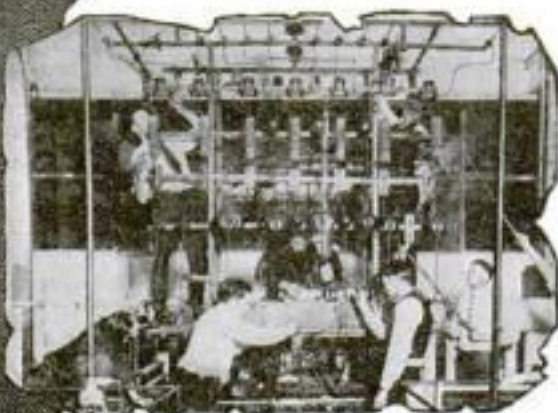


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POPULAR SCIENCE MONTHLY  
250 Fourth Ave., New York

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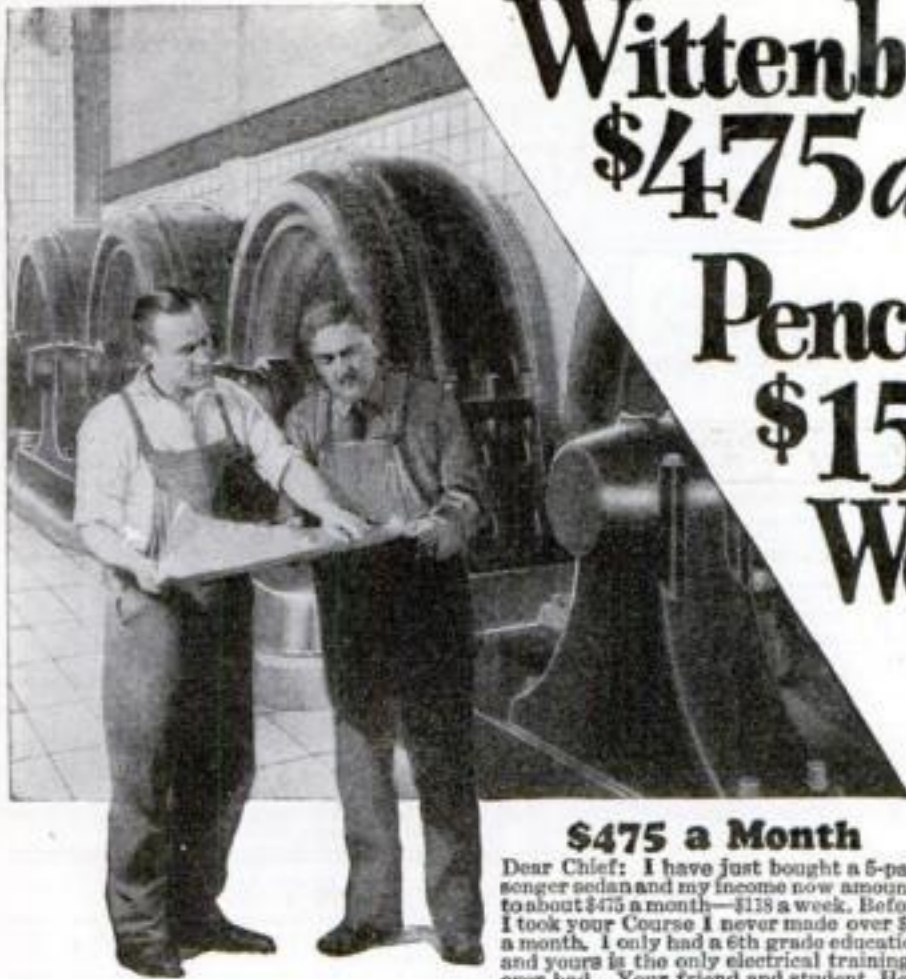
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And now you can learn the secrets of this science at home in your spare time. Any man with common school education and average ability can become a Finger Print Detective in a surprisingly short time.

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Just mail the coupon and we will send you without cost or obligation the bona fide reports made by Secret Service Operator No. 38 to his chief. Better than fiction! Leads you through every step in the solution of a mysterious murder and a daring train robbery. Shows how Finger Prints become infallible evidence.

Get the big illustrated book on true Finger Print cases now offered free. Also our special offer of a Professional Finger Print Outfit and a Course in Secret Service Intelligence now being made for a limited time. The coupon brings it all. Mail it now. You have everything to gain—Nothing to lose.

**University of Applied Science**  
1920 Sunnyside Av., Dept. 13-69 Chicago, Ill.

### University of Applied Science

1920 Sunnyside Ave., Dept. 13-69 Chicago, Illinois

Gentlemen: Without any obligation whatever, send me the Confidential Reports of Operator No. 38—also your big Finger Print Book and Special Offer now open.

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City and State \_\_\_\_\_ Age \_\_\_\_\_



### Patent Attorneys

MILLIONS spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free book—tells how to protect yourself, how to invent, ideas wanted! How we help you sell, etc. American Industries, Inc., 501 Victor Bldg., Washington, D. C.

PATENTS—Trade-Marks, all countries. Ten years' experience examining applications in Patent Office. Consultation invited. George Beeler, Patent Attorney, 150 Nassau Street, New York.

MONROE E. MILLER, Ouray Bldg., Washington, D. C., Patent Lawyer, Mechanical, Electrical Expert. Booklet and Priority Record blank gratis.

PATENTS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Alwine, Registered Patent Attorneys in United States and Canada, 232 Ouray Bldg., Washington, D. C.

PATENTS Procured: Trade Marks Registered.—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 41-Z Park Row, New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

RICHARD E. HADCOCK, Patent Lawyer, Washington Loan & Trust Bldg., Washington, D. C. Booklet.

PATENT Book Free. Charles W. Lovett, Patent Attorney, Lynn, Mass.

GET your own patents. Instruction \$1. Making Patents Pay. \$1. Cooper Cutting, Campbell, Calif.

INVENTORS who derive largest profits know and need certain simple but vital facts before applying for Patents. Our Book "Patent Sense" gives those facts; sent free. Write Lacey and Lacey, 648 F St., Washington, D. C., Established 1869.

### Patents for Sale

INVENTORS: Use our special service for presenting your invention or patent to manufacturers. Adam Fisher Mfg. Co., 183-A Enright, St. Louis, Mo.

OUTRIGHT or royalty, Fire Fighting Apparatus. No fire station is complete without this remarkable extinguisher. Jas. C. Will, Simmesport, La.

### Patents Wanted

PATENTS wanted:—We buy and sell practical patents. Big opportunity, undeveloped field. Describe briefly. M. Okamura, Box 1290, Honolulu, Hawaii.

### Photographs and Supplies

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

ESTABLISH yourself at home, as a photographic expert; make \$75 a week while learning; professional camera furnished free; write quick for full information. International Studios, Dept. 1743, 3601 Michigan Ave., Chicago.

WANTED—Representatives in every factory. Popular Science Monthly, 250 Fourth Ave., New York.

### Printing and Engraving

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Fantis Company, 525 South Dearborn Street, Chicago.

COMMERCIAL Printing—Office and Factory forms. Ask for prices—good work. Illinois Press, 833 First St., La Salle, Ill.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

THOUSAND Hammermill letterheads, four dollars. Multigraphing. Jno. Mavray, Monmouth, Illinois.

STATIONERY Embossers make Practical Christmas Gifts. Write to-day. Midwest, Box 47, Springfield, Illinois.

5000—20 L.B. Hammermill Bond letterheads \$12.75; 10,000—\$22.75; 5000—64 white wave envelopes \$9.00. Imitation typewriter letters our specialty. Write for prices. The Courier Company, Zanesville, Ohio.

FIVE hundred gummed stickers printed your name and address 25c. Premier Service, Antea Fort, Penna.

500 LETTER heads, 500 envelopes, \$5.00. Jean McLane, 1215 Russell Ave., Bethlehem, Pa.

200 SHEETS, 100 Envelopes Printed, Name, Address, linen stationery \$1.00 (west of Rockies \$1.10). Hi-Type Stationery Co., 153 Lafayette St., New Haven, Conn.

### Printing Outfits and Supplies

PRINT your own cards, stationery, circulars, paper, etc. Complete outfits \$8.85; Job Presses \$11, \$29; Rotary \$149. Print for others, big profit. All easy, rules sent. Write for catalog presses, type, paper, etc. Kelsey Company, F-3, Meriden, Conn.

### Radio and Supplies

TROUBLE-SHOOTING. Do you know the key to the knowledge of any electrical circuit? You can find correct answer in a booklet written by nationally known authorities on Radio and Electricity. Ask your radio dealer for "Practical Guide for Every Radio Builder and Owner," or send 10c to-day to Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill. Sold at all news stands in the City of Chicago.

RADIO Boosters—BCL's Wear our Radio Pin on your coat. Everyone admires it. \$1.00. S. K. W., 10 Westwood Drive, San Francisco, California.

### Razors and Blades

MIDGET Safety Razor, with dozen blades. 50 cents. Wallace Katz, 132 Chambers, Phillipsburg, N. J.

SAFETY Razor Blades—2 Doz. \$1.00, postpaid. Double edged. For Gillette and similar razors. Guaranteed good as any on market. Owl Supply Co., 3509 Ohio, St. Louis, Mo.

### Real Estate—Orchards—Farm Lands

PECAN-Orange-Fig Groves "On the Gulf" Monthly payments. Guaranteed care. Big, quick returns. Suburban Orchards, Dept. "S", Biloxi, Miss.

LAND free if planted to bananas. Bananas bear a full crop the second year. \$5.00 monthly will plant five acres, which should pay \$1,500 profit annually. Reliable Companies will cultivate and market your bananas for 34. Bananas ripen every day and you get your check every 90 days. For particulars address National Development Co., Empire Building, Block 134, Pittsburgh, Pa.

### Salesmen and Agents Wanted

AGENTS—Clever inventor! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Bldg., New York.

INSTANT Weld—Repairs large punctures without cement or heat. Lenn's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

GET our free sample case, toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F., St. Louis, Missouri.

AGENTS. \$60—\$200 a week. Genuine gold letters for store windows easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434-A N. Clark, Chicago.

TAKE orders for coffee, sugar, flour, meats, canned goods, staple groceries, also paints, radio sets, tires, auto and tractor oils. No capital or bond required. We deliver and collect. Permanent business. Big pay. Write at once. Hitchcock-Hill Co., Dept. 81, Chicago.

BANKRUPT and Rummage Sales. Make \$50.00 daily. We start you, furnishing everything. Distributors Dept. 34, 609 Division, Chicago.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gunmetal Co., Ave. F, Decatur, Illinois.

AGENTS—Best seller; Jam Rubber Repair for tires and tubes; supercedes vulcanization at a saving of over 800 per cent; put it on cold; it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and necessary dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building, Philadelphia, Pennsylvania.

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

AGENTS—Stamping names on Pocket Key Protectors; sample check with your name and address, 25c. Stamping Outfits, Emblem Checks, Check Fobs, Name Plates, Hart Mfg. Co., Desk 2—305 Degraw St., Brooklyn, N. Y.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

A BUSINESS of your own—Making Sparkling Glass Name and Number Plates, Checkerboards, Signs. Big Book and Sample free. E. Palmer, 513, Wooster, Ohio.

SELL by mail! Big Profits! Books, Formulas, Novelties, Bargains. Particulars Free! Elfeo, 523 South Dearborn Street, Chicago.

AGENTS—Make a dollar an hour. Sell Mendets, a patent patch for instantly mending leaks in all utensils. Sample package free. Collette Mfg. Co., Dept. 487, Amsterdam, N. Y.

EARN \$10 daily silvering mirrors, plating and refinishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Dele Laboratories, 1133 Broadway, New York.

MILLIONS stolen. Remarkable new \$5.00 Check Protector stops forgery. Inks, protects two colors. Sensational sales, profits. Write. Safety Devices Corp., Grand Rapids, Mich.

FORMULAS for making your own guaranteed products. Investment Small. No Machinery Needed. 300 to 1200% profit! Stamp Brings Interesting Descriptive Literature for Fly Killing Spray, Delicious Summer Drinks, Best Metal Polishing Cloth, Hair Marcell Liquid, No-Water Hand Soap, Lightning Battery Charging Liquid, Mendit, Fabric Patching Liquid; Amazon Tire Repair, Washing Compounds; Compellit Wood-stone, Wonder Gloss, Wizard Polish; Pure Food; Toilet, Medical Household Specialties. All lines. State what interests most. Miller, Chemist, 1706 Jettony, Tampa, Florida.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits. Exclusive territory. Write now, Connolly, 123 Liberty St., New York.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Address your inquiry to: Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Ave., New York.

POLMET Polishing Cloth cleans all metal. Sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

AGENTS—new plan, makes it easy to earn \$50.00 to \$100.00 weekly, selling shirts direct to wearer. No capital or experience needed. Represent a real manufacturer. Write now for free samples. Madison Company, 566 Broadway, New York.

AGENTS! Big money monogramming by transfer method. Catalog showing over 50 styles and particulars free. Motorists' Accessories Co., Mansfield, Ohio.

"GOLD" initials easily applied on Automobiles. Biggest money-maker today. Cost 5c, you get \$1.50. No experience needed. Free samples. "Balco" Monograms, 1043G Washington, Boston, Mass.

### Salesmen and Agents Wanted

35% COMMISSION. Sell "Name-on" Christmas Cards and boxes. Folder free. Wolfeprint, Lawndale, Philadelphia.

TO SELL Ray-O-Lite cigar and gas lighters. Big earnings. Sample 50c. Rapid Mfg. Co., 799-X, Broadway, New York.

ANY salesmen can sell them! Merchants everywhere use punchboards. Someone sells them, why not you? Collect big commissions daily. Newest, largest elaborate catalog sent upon request. Lincoln Sales Co., 9 S. Clinton, Chicago, Dept. G.

\$100-\$200 WEEKLY. Retailers live wire specialty \$40 weekly guaranteed against com. Reliable house. Guarantee dealers turnover or money-back. Pay you to investigate. Appleton Specialty Co., Cedar Rapids, Iowa.

AGENTS—Sell attractively displayed fast selling 5c candy specialties to stores—Big profits—Exclusive rights—Salesmanager, Box 971, Richmond, Va.

FORDS—No boiling, no freezing, big gas saving. Airlock absolutely does it. Sells like machine guns fire. Airlock Products, Burnett, California.

STARTLING selling plan! \$1.25 premium free to every customer on \$2.00 sale of 8 ounce Vanilla, 6 ounce Sham-poo and 4 ounce Lemon Lotion. Details and samples free. C. I. Togstad, Dept. 19T, 29 S. Clinton, Chicago, Ill.

GREAT neckwear line now free! Features finest quality neckwear at factory prices. Collect big commissions daily. Write for FREE de offer and FREE outfit. Nawro Neckwear, Desk 12-C, Covington, Ky.

McDONALD Polishing Cloth. Cleans gold, silver, nickel. Sample 15c silver. Daniel J. McDonald, 18 Agawam St., Lowell, Mass.

MR. ADVERTISER: Ask today for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 250 Fourth Avenue, New York.

AGENTS—Steady Income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main St., Brooklyn, N. Y.

"AMAZING New Cleaner" cleans everything. Sells 25c. Profit 17c. Sample Free. Bestever Products Co., 1943-P, Irving Park, Chicago.

AUTO Emblems. Any Lodge. Write. North Central Distributors, Dept. M, Ashland, Ohio.

AGENTS—Sell Scientific Device for Fords. Prevents overheating. Guaranteed to cool motor, better than water pump together with regular fan. Best seller of the season. Write for particulars. Debothezat Impeller Co., 1922 Park Ave., New York.

SELL new and used clothing to general Stores and Tailors. Numerous other new articles. Good pay. Young Co., Dept. P, 2549 So. Halsted, Chicago.

MAKE \$100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$100 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, Inc., 431 N. La Salle, Ave. L, Chicago.

NEW Ford shock absorbers retail at \$3.00—100% profit. Also other good money makers—500% profits. Free sample of windshield coatings. Safe-Vu Co., Dept. A., St. Louis.

SALESMEN We Pay You Well. Hardensburg's famous line of leather goods, diaries, calendars and other advertising specialties. Product of 48 years' experience. Easy sales, satisfied customers, big commissions. Serious offer for hustling salesmen. H. B. Hardenburg & Co., Inc., 423 Elizabeth Ave., Linden, N. J.

SELL Aprons, Season's Biggest Hit. Easy to earn \$15 in single afternoon. Everybody buys. No competition. Selling outfit furnished. Write today for special agents offer. Apronall Co., Chamberlain, S. D.

SALESMEN—Tremendous Repeater. Used by Millions. \$20 profit on ten, \$3.50 sales. Merchants repeat orders build you permanent business. Auto Bonus. Territory. Full or side line. Hustlers wanted only. Elcor Products, Dept. M-10, Washington, D. C.

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MANUFACTURER Lambs Wool, Polishers, Dusters. Newhall, 358 Broad, Lynn, Mass.

STOP Wasting Time. Send name, address. "Nuff said." German G. Martin, Box 124 East Ave. Sta., Rochester, N. Y.

AGENTS wanted to distribute samples, big money, new method, write quick. P. S. Vann, Box 3, Sta. D, New York.

AGENTS: Make \$500.00 before Xmas. Pay daily. No investment. Rhinestone initial Buckles and novelties. Big Xmas and all year sellers. Exclusive territory. Clanton Novelty Co., 606 Blue Island, Chicago.

AGENTS wanted. 20 shaves \$1.00. New Liquid eliminates razor. Yours for the price. Hylon Laboratories, 2704 North Halsted St., Chicago.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 250 Fourth Ave., New York.

PROFITS 100% selling quality guaranteed perfumes and toilet preparations that produce permanent repeat sales. Liberal free goods. LeMaire Perfume Co., 3330 Carroll Ave., Chicago, Ill., Dept. 79.

AGENTS for well known automobile polish—full or part time basis. Experience not necessary. Ambitious man, willing to work, can make real money on this proposition. Big commission allowed. A real opportunity for the right man. Barthel Laboratories, 4350 Webster Ave., N. Y.

WONDERFUL Pocket Adding Machine and Magic Writing Pad. Retail \$3.00. To Agents 50c in quantities. Particulars Free. Typewriter Supply Co., 541 Hersch Bldg., Pittsburgh, Pa.

SALESMEN to sell all wool, hand tailored, made to measure, suits and overcoats \$23.50. Commission \$3.50. Large line 6x9 sample swatches, easy to sell. Write for sales plan. Helm Tailoring Company, Department 7, 616 W. Baltimore Street, Baltimore, Md.



# Be my partner!

start your own TIRE BUSINESS

sell this marvelous tire  
**INSURED**—for One Full  
Year **FREE!**

Make up to \$100 Weekly by Taking an Agency  
for Hydro 'Insured' Tires—Sold Only Thru  
Authorized Salesmen-Agents

If you would break away from the monotonous routine of working long hours for a small salary—if you would want a snug bank account—if you want full or spare time occupation in dignified and fascinating work—**BE MY PARTNER!** Become an agent for **HYDRO 'Insured' TIRES** and with my assistance you will quickly establish a profitable tire business right in your own community. Every car owner wants Hydro Tires because they have *no competition in price—no rival in quality—no imitation in appearance—and no equal in the insured protection to the user.*

No capital is required! The Hydro Plan is based on the fact that in every community there are worthy men who could easily become successful if they had the proper incentive. Many of these men are harder workers, better salesmen, and capable of making more money for themselves than the dealer who waits for business to come to his store. Perhaps **YOU** are the man we are looking for! If so, here is the chance of a lifetime to earn *real money*, because you sell a necessity that has *one of the greatest markets in the world.* Your prospects are limited only by the number of cars in your territory. Investigate!

The User's **FIRST** and **ONLY** Cost  
less than Dealer's Prices on  
other Uninsured Brands

Ours is the only tire factory in America selling its product only through authorized Salesmen-Agents. Eliminating the

profits of jobbers, brokers and dealers enables us to offer car owners, real, outstanding Tire Values which mean quick sales

## HYDRO

*Insured* **TIRES**  
"The Most Beautiful Tire in America"

**HYDRO TIRES**—un-surpassed in quality and outstanding in performance, are definitely insured for **ONE FULL YEAR** against everything except theft! Each user is furnished with a Tire Insurance Policy that assures him a year's tire service

regardless of wear or mileage. This is the sort of protection every car owner wants and Hydro is the first to offer it. It is the user's Guarantee of Service. Be the first in your community to sell tires that are completely **INSURED** for one year

**Act Now! Before Your Territory is Allotted**

The man who succeeds and makes money is he who grasps an opportunity quickly. Hydro Agents are accepted on the exclusive territory basis. I want you to represent me in your territory, where there are thousands of dollars in profits waiting for some live hustler. I'll give you every cooperation. Just send us the coupon below and you can get started at once.

*J. G. Frost*  
President.

**SEND**  
for Your  
**SELLING**  
**KIT** now!



This valuable KIT, complete for making demonstrations and easy sales, is supplied to Hydro Agents under our Agency plan.

**THE BUSINESS OPPORTUNITY OF A LIFETIME!**

Want to make extra money evenings and during spare time? Want to establish yourself in an enjoyable, profitable business of your own? Send now for complete details of the Hydro Exclusive Agency plan! Be a Partner in this \$1,500,000. company. Ambitious men are now making money by selling **HYDRO TIRES.** You can too!

Send us **Coupon NOW!**

**HYDRO-UNITED TIRE CORPORATION, Pottstown, Pa.**

Tell me how I can secure the Hydro Agency for my territory, and make up to \$100 per week as your representative. This does not obligate me in any way. PSM-12-26

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

HYDRO-UNITED TIRE CORP., POTTSTOWN, PA.



10 DAYS' TRIAL  
SEND NO  
MONEY



NO  
NEED  
FOR A  
NEW  
PHONOGRAPH

## —The New PHONIC Reproducer

makes an up-to-the-minute  
Phonograph out of your old one

for **\$3.85**  
only **3** Direct  
from  
Factory

Gives the New Tone and Volume of  
Latest New Phonographs

Now at last you can say goodbye to the squeaky, nasal, rasping, metallic tone of your phonograph. Now you can have the beautiful, natural, full-rounded tone of the expensive new machines which are startling the world. Yet you need not buy a new phonograph if you have an old one. The reproducer is the HEART of any phonograph—and the New PHONIC reproducer makes your old phonograph like an entirely new one. Based on the new PHONIC principle. Makes you think the orchestra or artist is in the same room.

### Never Before Such Tone

Tones never before heard are clearly distinguished when the new PHONIC reproducer is used. Test it on an old record. Hear the difference yourself. Listen to the deep low notes and the delicate high notes. Hear how plainly and clearly the voice sounds. Note the natural tone of the violin and the piano, and the absence of "tinny" music. You will be amazed.

### Volume Without Distortion

The new PHONIC reproducer is ideal for dancing or for home entertainments. Its volume is almost double that of the ordinary reproducer. Yet there is no distortion of sound. The new principle enables you to use even the very loudest tone needles without the ear-splitting effects of old reproducers. The new PHONIC is always mellow and natural.

### 10 Days' Trial—Send No Money

You cannot realize how wonderful the New PHONIC is until you hear it. That is why we want to send it to you on 10 days' trial. Send no money now—just the coupon. Pay the postman only \$3.85 plus a few pennies postage when the New PHONIC arrives. Then if you are not delighted, send it back within 10 days and your money will be refunded. The low price is made possible by dealing direct with phonograph owners. If sold in stores the price would be at least \$7.50. Our price only \$3.85. Over 350,000 people have dealt with us by mail. You take no risk. Mail coupon now for 10 days' trial. BE SURE TO STATE NAME OF PHONOGRAPH YOU OWN.

NATIONAL MUSIC LOVERS, Inc., Dept. 812  
327 West 36th Street, New York

Please send me a New PHONIC reproducer for

I will pay the postman \$3.85  
(give name of Phonograph) plus few cents postage. If I  
am not satisfied after trial, I will return your reproducer  
within 10 days and you guarantee to refund my money.

Name.....

Address.....

City..... State.....

Outside U. S. \$4.10, cash with order.

### Salesmen and Agents Wanted

BUY our absolute necessity 2c—sells 25c. We undersell all. Seven samples 30c. Catalog free. Mills Sales Co., 13 E. 16 St., New York.

EARN \$45 to \$85 extra a week. Selling beautiful shirts. Commission in advance. We deliver and collect. Write quick. Fashion Wear Shirts, Dept. 8-632, Cincinnati, Ohio.

MAKE—SELL Your Own Goods. Formulas by experts. Manufacturing Processes. Trade-Secrets. All kinds. All lines. Catalog, circulars free. C. Thaxby Co., Washington, D. C.

AGENTS—\$11.50 Daily in advance (Sworn Proof) Introducing New Insured Hosiery. Guaranteed one year. No capital or experience required. Your pay daily. Monthly bonus besides. Spare time pays you big. We supply samples. Silk hose for your own use Free. Macoshee Hosiery Company, Card 15212, Cincinnati, Ohio.

AGENTS—Big Seller—\$20 Daily Easy selling Taylor Caps—made-to-measure—every man buys—some want 2 or 3 caps. Samples Free and Cap Free to agents. Write quick for fast money making proposition. Taylor Cap Manufacturers, Dept. O-5, Cincinnati, Ohio.

\$14.50 DAILY Easy—Pay in Advance. Introducing Chieftain Guaranteed Shirts 3 for \$4.95. No experience or capital needed. Just write orders. We deliver and collect. Full working outfit Free. Cincinnati Shirt Company, Secy. 16016, Cincinnati, Ohio.

FIRE Salvage Rummage Sales. \$50.00 Daily. We start you furnishing everything. Jobbers Desk M14, 1608 So. Halsted, Chicago.

AGENTS \$72 Week. Brand new tool chest, 8 tools in one. Fine leather case. Fits hip pocket. Demand enormous. Write quick. Novelty Cutlery Co., Chest 232, Canton, Ohio.

MAGIC Moving Window Salesman. Its real changeable letter system has actually boosted users' sales 200% to 400%. None but dead dealers indifferent. If you can spot a winner, get the facts and begin pocketing \$100 weekly. Display Products Company, P. O. Box H5123, Gateway Station, Kansas City, Mo.

DISCOVERED! Diamond's Rival—Rajah Gems astound Jewelry world and defy detection. Set in artistic Sterling Silver mountings, copies of highest priced platinum designs. Sell like wildfire at popular prices. Salesmen and Agents unique selling plan means enormous profits for you. Write immediately for details. Rajah Company, Dept. Z-12, Salisbury, N. C.

AGENTS—Biggest money makers ever offered. Sell offices, homes Bestufone, which makes both hands free while telephoning; Midget Collapsible Garment Hangers. Wonderful Holiday Sellers and Everin Key-purse to hold change and keys. H. Kalina Company, 1308 Avenue N, Brooklyn, N. Y.

AGENTS—Our gold-eyed needle cases are wonderful sellers: immense profits; \$50 to \$300 weekly; proof and particulars free; sample outfit 15c. Paty Needle Co., Somerville, Mass.

SELL men's neckwear; wonderful proposition. Astor, 318-G Broadway, New York.

SALESMEN, go into the office accessory and supply business. We furnish complete lineup. Build a permanent business that pays big money. Write for particulars. Davis Company, 10 Tremont, Boston, Mass.

AGENT makes \$57 a day driving nails in tire! Amazing discovery heals all punctures—one tire was punctured 857 times without a leak. Send for free Sample Offer. O. S. Nelson, T-3189 Logan Bldg., Mitchell, S. Dak.

FREE Adding Machine to "Live-Wires" accepting our Dollar-a-Minute Agency. Improved 2-lb. Calculator. Adds, Subtracts, Multiplies, Divides. Work equals \$300 machines. Retail \$15.00. Big demand; large profits. Write quick for protected territory. Lightning Calculator Co., Dept. P, Grand Rapids, Mich.

AGENTS wanted to advertise our goods and distribute free samples to consumers; 90c an hour; write for full particulars. American Products Co., 6327 Monmouth, Cincinnati, Ohio.

MIRRORS resilvered at home. Costs less 5 cents per square foot; you charge 75 cents. Immense profits, plating auto parts, reflectors, tableware, stoves. Refinishing metalware, etc. Outfits furnished. Write for information. Sprinkle, Plater, 96, Marion, Indiana.

NO DULL times selling food. People must eat. Federal distributors make big money; \$3,000 yearly and up. No capital or experience needed; guaranteed sales; unsold goods may be returned. We furnish you with sample case, license and free samples for customers! Sure repeat orders. Exclusive territory. Ask now! Federal Pure Food Co., AA2307 Archer, Chicago.

SELL Radium Water Generators. Entirely new fast seller, repeat orders sure. Permanent income. Ask Why to-day. Radium Refinery, 2209 Broadway, Oakland, Calif.

SURE Seller to every merchant—no gamble—big profits—steady repeater—free sample and exclusive territory. Embossed Show Card Co., 9462 Euclid, Cleveland, Ohio.

AMAZING large cash commissions introducing beautiful \$3.95 and \$4.95 Fit-to-Measure guaranteed shoes. Actual samples furnished. Write for your territory. Style Arch Shoe Co., Dept. 106-M, Cincinnati, Ohio.

AMAZING new invention, duplicates anything type-written, handwritten, drawn, ruled. Inexpensive, easily operated. Salesmen coining money. Write free sample offer today! Stenograph, 1271 California, San Francisco.

REAL Selling Sensation! Tremendous earnings whole or part time! Patented Hot Water Bottle Combination. Invention needed everywhere. Big commissions. Extra bonus. We deliver. Write C1015 Lobi Corp., Middleboro, Mass.

WE PAY \$48 a week, furnish auto and expenses to introduce our Soap and Washing Powder. Buss-Beach Company, Dept. A48, Chippewa Falls, Wis.

MERCHANTS now buying gift advertising. Sell red bird flyer—kitchen tongs—auto smoker set—novelty calendars, etc.. Good sideline. Newton Mfg. Co., Advertising Dept., Newton, Iowa.

AUTO Radiator Shutter just out. \$20.00 daily easy. Big winter seller. Retail \$1.50. Jones, 802 N. Clark, Chicago.

SELLING like blazes! Eleven piece toilet goods assortment at \$2.25 with two piece carving set FREE to your customers. 100% profit. Davis Products Co., Dept. 57, 1321 Carroll, Chicago.

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## "It's Brains Against Brains —Fighting Gorillas!"

(Continued from page 133)

gun boy. But in the middle of the field squatted a squirming sack containing Bula Matadi, the largest gorilla ever caught, alive and unharmed.

"Bula Matadi, however, did not live to reach the coast. Five of the eight gorillas I captured on my two collecting trips died from various causes. Bula Matadi was stung to death by a troop of marching ants which visited his cage one night, as the camp slept.

"ON MY first gorilla expedition, in 1922, all but one of the captives died on the long march through British East Africa to the Indian ocean. That one I gave to the Antwerp Zoo, where it died a year later. On both trips I entered Africa at the mouth of the Congo and came out clear across the continent on the east coast. The last time I had two gorillas alive when I reached the coast, one for the Antwerp Zoo and one for myself. Again the one I left in Belgium died, so that Miss Congo is the only survivor of the eight. She is a wonderful animal, almost human. You ought to go over to my brother's country place, at South Jacksonville, and see her."

I did. I spent half a day visiting the only living captive gorilla in the world, and marveling at her likeness to a human being. What struck me as most human-like were the shape of her skull, her use of the facial muscles of expression, which are hardly developed at all in the other apes and only partly in many of the dark-skinned races of man, the perfection of her ears, precisely like human ears—the gorilla is the only animal besides man which has ear lobes—and the perfect human type of her finger nails. Except for her inability to oppose her thumbs to her fingers, her hands are like those of a human, and she uses them as deftly as many human beings use theirs.

THERE is no doubt in my mind, after watching Miss Congo's manifestations of intelligence, that she possesses a quality of intellect comparable with that of human beings. That she can think and reason intelligently to a conclusion, instead of acting solely from instinct and imitation as in the case of every other beast, is also the verdict of Dr. Robert M. Yerkes, the distinguished psychologist and editor of the Journal of Comparative Psychology, who had just completed a six weeks' test of the young gorilla's mental powers when I visited her.

One of Dr. Yerkes' tests was particularly conclusive. An orange, of which the gorilla is especially fond, was hung at a point where, in order to reach it, she would need a stepladder or its equivalent. Three grocery boxes were scattered about the yard, within her reach as she roamed at the end of the long chain with which she is kept fastened to a huge live-oak. (Yale locks are used, incidentally, since Miss Congo learned how to manipulate the common snaffles first used and began to roam around the banks of the St. Johns River.)

She surveyed the (Continued on page 144)



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## "It's Brains Against Brains—Fighting Gorillas!"

(Continued from page 143)

orange, quickly concluded it was beyond her reach, scratched her ear for a moment, then examined one of the boxes reflectively. Suddenly the idea struck her. She dragged the box under the orange, climbed up on it and tried to reach the fruit. It was still too high. She sat a while in deep thought, then got a second box and piled it on the first. She seemed to recognize that she had found the method, for when she failed on her second attempt to get the orange it took her but a moment to pile the third box on the other two, clamber up and seize the fruit.

ANOTHER test consisted of placing an apple inside of a length of drainpipe, out of her reach, and leaving a pole lying where she could get it. After trying to reach the apple with her hand, she took only a short time for reflection before getting the pole and poking the apple out of the pipe. A memory test which she successfully passed was letting her see some food of which she is fond placed in a glass jar and buried in the sand, then several days later letting her loose in the neighborhood of the cache. She remembered and quickly unearthed the jar.

Most of the deaths of gorillas in captivity, Mr. Burbridge believes, have been due to too close confinement, improper feeding and the contracting of diseases, such as colds, pneumonia and tuberculosis, because of too close association with people. Miss Congo has been kept out of doors ever since she came to America and has never been ill. When she was brought to Jacksonville she weighed forty-five pounds; eight months later she had grown to one hundred pounds, under the careful feeding of Mr. Burbridge's sister-in-law, Mrs. James D. Burbridge, of whom the gorilla is especially fond.

Since the normal span of life of the gorilla is believed to be about the same as that of man, Miss Congo is not expected to reach maturity for another eight or ten years, and her captor and foster mother hope that she may furnish a fruitful field for another fifty years and more for the study of her mysterious race and the relationship between man and the beasts.

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## New Crime Remedies

(Continued from page 13)

the records of Dr. Wechsler's emotion detector, the truth serum results form a part of the evidence which a psychological detective can accumulate and which he must take into account in forming his conclusions.

A case of Dr. House's illustrates this. A boy was accused of having been one of two men involved in a holdup. The other man was shot dead and the boy was arrested on the spot, the two victims who had been attacked having been policemen in disguise. The case was apparently a clear one. Dr. House tried his serum on the boy, with the latter's consent.


**U**NDER the drug there came out an almost unbelievable story of how the lad had been induced to join the excursion, without knowing its purpose, by the man who had been shot dead. The boy was truthful. Facts already in possession of the police fitted into the tale. They explained the story; the story explained them. The lad was freed, thus saving an innocent person from virtually certain conviction.

Another famous murder case which has cost an enormous sum and is still not settled to universal satisfaction is the Massachusetts case of Sacco and Vanzetti. On April 15, 1920, a paymaster was held up and killed. Sacco and Vanzetti, who are anarchists, were arrested, tried and convicted. Alibis presented for them were rejected, although on the face of the record they seem strong. The case has been re-opened recently for a new trial.

Here we have a case in which the psychological examination of the accused men would undoubtedly be useful. It is almost unthinkable that these two men, neither of them experienced in deceit, could go through a careful examination by a skilled psychologist without disclosing facts which would help vitally to determine their guilt or innocence. If these men are innocent, an examination of this kind might save them from terrible injustice. In fact, more than one instance of miscarriage of justice in the past could not have happened had psychological examination of prisoners been in vogue.

**I**N NOVEMBER, 1917, Mrs. Annetta Morello killed herself in her room in Newark, New Jersey, because her husband had been drafted and was going to war. Her husband was in the room at the time. He was arrested and examined, in Italian, through interpreters who were not sufficiently familiar with the dialect which he spoke. He was convicted, the interpreter having reported that he confessed, whereas he had really tried to say that his wife had committed suicide. Not until 1926 was the mistake discovered and Morello freed, after eight years of jail.

In at least some of these cases devices like Dr. Wechsler's would have helped to extract the real truth from the witnesses. In others, the second kind of psychological investigation could have been employed, the kind which helps us to decide whether the crime and the suspected criminal are psychological mates. (Continued on page 146)



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## New Crime Remedies

(Continued from page 145)

In a famous British case of eighteen years ago, the case of the murder of Marion Gilchrist, tests of this kind would probably have saved an innocent man from prison—or hanged him if he was guilty.

Marion Gilchrist was an elderly spinster who lived alone in a small apartment in the city of Glasgow, Scotland. On December 21, 1908, she was brutally murdered in her home. A man was seen running away but was not captured. Four months later a man named Oscar Slater was arrested, convicted and sentenced to be hanged. There were grave doubts of his guilt, which was indicated almost entirely by circumstantial evidence in which it is quite possible, even at this late day, to pick serious flaws. Influenced by this fact, the Home Secretary, who is the pardoning authority in the British Isles, commuted Slater's sentence to life imprisonment. So far as I know he is in prison yet.

**I**F SLATER was innocent, a fearful miscarriage of justice has occurred. If he was guilty, there was still a miscarriage, for in this case the Scottish law required that he be hanged.

An experienced detective or criminal judge acquires, of course, instinctive power of judging this ability or inability of a certain suspect to commit a given crime. "That's not his kind of a job," they say. Usually they are right. It is merely long experience and acute observation of character. What a series of psychological tests can do is to supplement this; to do it better and more certainly.

The tests used for this purpose are similar to those now used by many businesses in selecting employees. They determine the habitual quickness of movement and of reaction to stimuli, like noises or touches. They test general intelligence, also, and mental stability of the witness or his tendency to get excited in an emergency. Still others test his muscle control—a matter of importance, for example, in deciding whether he could fire a revolver accurately during a moment of excitement.

**B**EGINNINGS in these psychological methods of criminal examination have been made in several cities, notably in Berkeley, California, where Police Chief August Vollmer is well-known for his close contact with the scientific departments of the University of California and for his use of science of all kinds in the city police work. In some of the larger cities, notably in Los Angeles, Calif., and in New York City, some tests have been made with such methods.

Every court or police station having to do with many criminal cases should possess its psychological laboratory, equipped with apparatus for the general testing of character, and in charge of a competent and experienced psychologist. In cases like the Hall-Mills case or the Sacco-Vanzetti case the savings to the state would be thousands of dollars, now spent in the examination of witnesses who disclose nothing important.

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## A Camera Hunter Tells His Secrets

(Continued from page 19)

best. The camera, adjusted for sharp focus at thirty feet, is supported from a board across the bow and the flash lamps are about thirty inches above. Another camera may be focused at twenty feet.

Noiselessly, the boat pushes off into the darkness. The photographer kneels in the bow, just behind the camera, ready to push the button that sets off the flash powder. The powerful twin flash lamp, only two feet above his head, is loaded with two tremendous charges of high-speed powder which, when they explode, can be heard two or three miles and seen in the sky ten or fifteen.

**H**E TURNS the jack from side to side, lighting up the wooded shore. Suddenly two bright balls of fire appear. A gray form becomes visible and at last the watchers see the graceful image of the deer. The jack blinds him and he cannot see the boat behind. As the light drifts slowly, silently nearer, the deer becomes nervous, more nervous. And at thirty feet, the photographer presses the button. With a roar and a blinding light, in a 200th part of a second the picture has been taken. As the echoes die, the snort of the fleeing deer is heard.

At the other end of the scale is the photography of insects—a wide field, for there are 250,000 known species of them. Insects are usually photographed by being put in a glass-sided cage and given an hour to quiet down. But very active specimens have to be chloroformed for a few seconds and photographed before they "come out." A most interesting series of pictures can be taken through the night, by flashlight, of a spider spinning its web.

Remarkable close-up photographs of monstrous insects now are being made by a new device, a camera fifty feet long. This is constructed by mounting an extra long focus lens on a long light-tight wooden trough, painted black inside to prevent reflections. The insect is placed on a block, which is moved before the camera until sharp focus is obtained, and the lens stopped down to increase the depth of sharp-focus field without prolonging the exposure too much.

**T**HERE are all kinds of ruses to outwit the birds you want to photograph, says Mr. Nesbit. One is to put a feeding station on your window sill and take the picture from inside. To catch a woodpecker, put suet in the crevices of the bark of a tree, but if you want to get his head while he is pecking, you need a shutter speed of 1/300th of a second.

One of the best known wild life pictures is that of a fish hawk in the act of striking the water after a fish. The photographer anchored a wooden goldfish six inches below the surface, with a thread reaching to the shore. He himself hid behind a blind on the shore, his camera ready and focused. When the hawk hove in sight, he jerked the thread, moving the fish to attract the hawk's eye. Then came the swoop.

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## They Can Fly with Their Eyes Shut

(Continued from page 21)

I was absolutely as well as hopelessly lost. "I dropped a flare, and in landing hit a tree. I was in Bloomsburg.

"Almost exactly one year later—the night of the Dempsey-Tunney fight—after flying blind for nearly two hours in the fog, I came out of it; again I was over Bloomsburg. But this time I knew exactly where I was."

What Captain Chandler considers his narrowest escape also occurred near Bloomsburg. Having passed over the city, he lost his direction in the fog. He turned and again flew over the city. Then he dropped a flare. The magnesium light disclosed an oat field opposite Rupert, in which he made a perfect landing. Getting his bearings quickly, he prepared to take-off. By this time a crowd had gathered and stood watching him.

CHANDLER shouted a warning and started off. The plane bounced unevenly over the oat field, and began to rise. Too late, Chandler realized that the oat stalks had become entangled in his landing wheels and were diminishing his speed as he rose.

Looming up ahead, too close to avoid, and too high to clear with his retarded plane, was a huge tree. Beyond was the Susquehanna river.

A cry of dismay from the spectators, a crash of rending timber, and the great plane had rushed headlong into the top of the tree. Carrying top and limbs with it, the ship plunged toward the river. It staggered, then landed on its side, twenty feet away, in four feet of water.

Campers rushed to the rescue. They found Chandler amid a heap of branches and wreckage. The right wing of the plane had bent over, pinning him tightly. Fortunately his head was out of water, but he was bleeding profusely. Portions of the cockpit had to be chopped away before he could be released and carried to a hospital. There it was found he had suffered a fractured skull, a broken nose, and lacerations of the head and face; yet over the protests of the doctors he directed from his bed the disposal of his entire cargo until it was in the hands of the postal authorities.

DEAN SMITH can boast of being the only air mail pilot who ever ran down a cow.

While flying the mail route from Chicago to Omaha, he stripped his gears and was forced to attempt a landing in an open field. It was a cow pasture.

The wheels had barely touched the ground when the cow stopped directly in the path of the plane. Plunging ahead at eighty miles, the nose of the machine caught her squarely. In a shower of blood, the plane did a cartwheel, twisted out of shape, and landed on its back.

In flying the Cheyenne westward route, Captain Chandler's nerve and resourcefulness saved him from what might have been a fatal accident.

As he rose from the field at Cheyenne one day, the left wheel on the ship's landing gear flew (Continued on page 159)

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## They Can Fly with Their Eyes Shut

(Continued from page 148)

off. Unaware of the loss, he continued on his flight in ignorance of the danger which awaited his descent.

**O**BSERVERS on the field at Cheyenne saw the wheel as it fell, but they were powerless; for the plane was already passing out of sight. Knowing the risk that Chandler would take in landing with one wheel missing, they quickly communicated with the field at Rawlins, Wyo., over which the pilot would pass.

It was fortunate for Chandler that he was not forced down before he reached Rawlins. Luck was with him. While passing over the field at Rawlins, the captain saw that he was being signalled to stop. "That's peculiar," he thought, as he circled around. Next he saw that the men on the field were holding something up to him. Sailing lower, he recognized it as a wheel. He immediately inspected his ship and discovered the damage. The ingenious method he employed to meet this situation has since been generally adopted.

**"T**HE possibility of such an emergency had often occurred to me and I had worked out a plan whereby I could land in safety," he said, describing how he did it. "I brought the ship down in such a manner as to let the wind strike it from the left—the side of the lost wheel. At the same time, just as I touched the ground, I dropped the right wing slightly, keeping the tail high.

"In this manner I rolled about fifty feet on one wheel and greatly decreased my speed. As the left side began to settle, I turned, at first slowly, then sharply to the right. This produced the same result as does the act of turning an auto suddenly; it tended to upset the plane to the right and put all the weight on one wheel.

"By this time so much speed had been lost that I was unable to keep the butt of the wheelless axle out of the ground any longer. I came to a full stop without damage to the ship or myself."

**W**HILE the air mail pilots already have taken aviation out of the hit or miss class, they foresee still greater strides in the near future. They predict a time—perhaps within a year—when they will be able to fly regardless of weather, keeping accurately to any course. That will be possible through the use of the radio compass, constant weather reports, and multiple motored ships. A plane with multiple motors will have little to fear from engine trouble, and forced landings from that source will be all but eliminated. The radio compass will tell them, by a system of signals, whenever they are about to stray from the route.

But whatever the perfection of the instruments, the success of the air mail will always depend on the courage and determination of the pilots. They will always go forth to do battle with the fog, the wind, the rain, and the ice. The instruments can tell the aviator what to do; but it will always be up to him to do it.

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(Continued from page 23)

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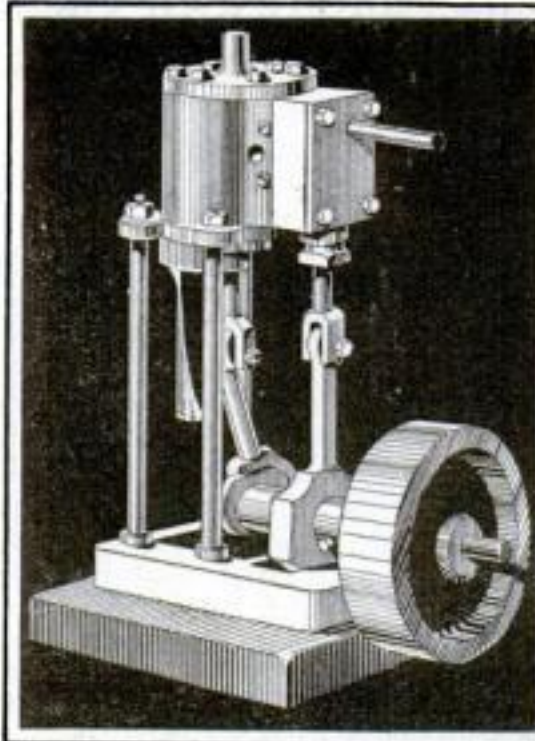
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Professor Norris is only one of many eminent scientists who are hopeful we will get at the tremendous power of the atom sooner or later. When we do find it and the means of harnessing and distributing it, we may look for an era of wonders that will make our present mechanical age appear primitive.



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## The New Wonders of the Sea

(Continued from page 26)

ment through the blood of the female. They lose their teeth and luminescence and become almost blind.

Deep-sea fishes have the most freakish forms. Part of the skeleton of the *Sternoptyx*, for instance, is visible outside of his body. He is bent downward, his tail far higher than his head. This is supposedly an adaptation to deep water pressure, as is the boot-shaped jellyfish that lives 8,000 feet down. The *Argyropelecus* is entirely luminescent. Its eyes, which are enormous and are on the top of its head, are turned upward. Did you ever hear of a butterfly fish? No, it isn't a joke from Alice in Wonderland. It exists, and has wings beautifully colored, like those of a butterfly, in deep blue and vermilion and yellow. You wouldn't think paper would last long in the ocean, but the paper nautilus is a little octopus, and he lives in a delicate tissue paper shell in which he can float about on the surface.

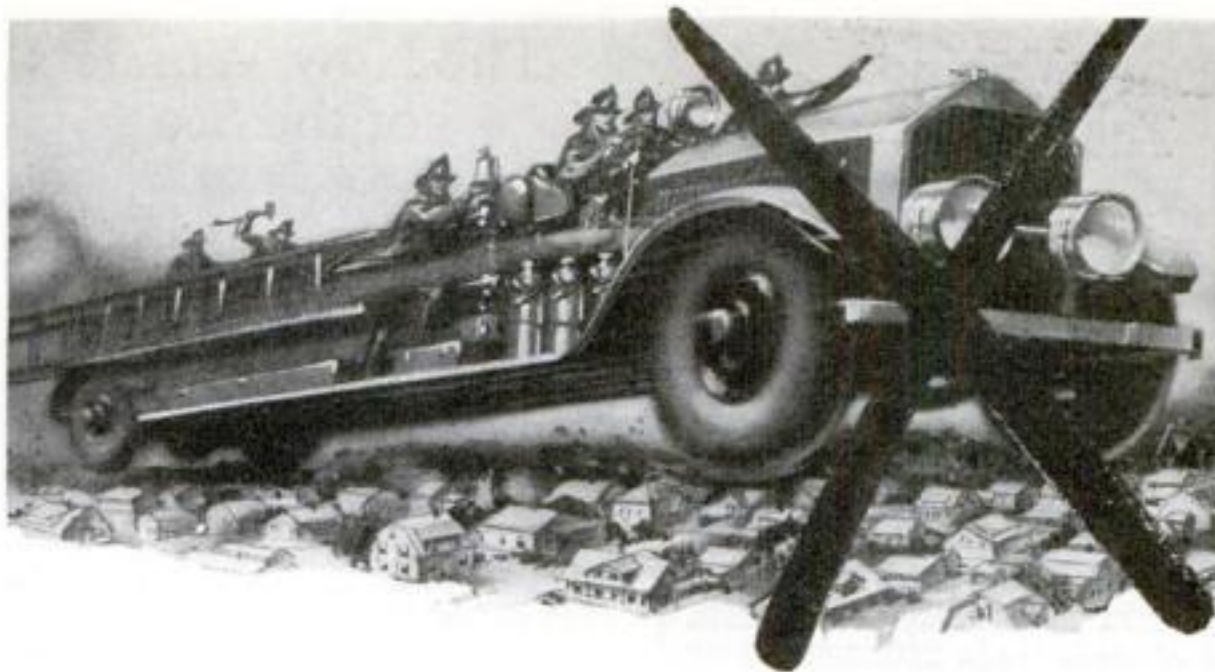
**T**HEN there are fishes with "panes of glass" in their stomachs, transparent membranes through which the internal organs can be seen. There is the Union Jack fish caught recently in South African waters, during the discussion whether the Union of South Africa should continue to use the British emblem and which got its name from the fact that the markings on the fish's side resembled closely the Union Jack.

All fishes are not as cold as they look, and they do make love. Professor Julian Huxley has been peeking, and has seen them. Crabs aren't really crabbed, he says, for he has seen the male fiddler crab courting. When the lady crab comes along, the gentleman stands on tiptoe and holds aloft a highly colored claw. If she passes him by the first time, he tries another attitude. Male spiders carry flies, wrapped up, to their lady loves; but the later sometimes eat their husbands on the honeymoon. The marine bristle worm is lured from its home by the moon, and seeks the female, to sport in dances by moonlight. Imponderable are the ways of nature.

**O**NE of the greatest wonders of the sea is plankton, the teeming life best known as causing oceanic phosphorescence. Those waves that seem just water, whether blue, or green or gray, are often full of minute living things, each with its own individuality, each living out its little life.

Plankton is the star dust of the sea, floating life that drifts with winds and currents, and at night glows and glimmers as the ship ploughs its way along. It is twenty-five times as efficient a light producer as an electric bulb. It makes the sea an opaque, oxidized liquid as different from water as tar is from glass. It resembles in appearance a rich pink jelly. Its numbers are as the sands, uncountable. A gauze net with an opening a yard wide, yielded to Beebe on the *Arcturus* a haul, one 150th of which he estimated to number 271,080.

(Continued on page 152)



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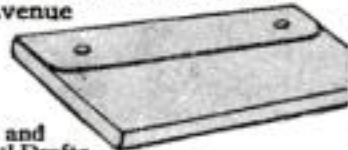
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## The New Wonders of the Sea

(Continued from page 151)

Multiply that by 150 and you get 40,662,000, which was the total haul in that one small net. Plankton is commonly called "whale food" and many fishes eat it. Human beings could live on it if they had to. It is rich in nourishment. The whole human race may some day have to depend upon it, for the fish supply is decreasing, the price is going up, and the lack may have to be filled from the untapped larder of the sea.

When we say "sea food" we think of fish and lobsters, oysters and crabs. The prices of these are going up, but there is an endless supply of other sea food. French scientists have investigated and say that all races can eat seaweed with profit, as Chinese and Japanese do already. It is as nourishing as carrots, beets, turnips and parsnips.

All clams, cockles, scallops and even barnacles are edible. A giant barnacle, *balanus evermanni*, that abounds on our Pacific coast, has a delicious flavor and the same food value as lobsters, prawns and crabs. Even the dread octopus can be, and is, eaten in Eastern Asia. The sea cucumbers—they are animals—which we do not eat, sell in Hongkong at \$700 a ton.

WHEN McGinty got to the bottom of the sea, he found magnificent scenery unparalleled on land. In the tropics, with coral, sponge and colored shells and plants, the vista is brilliantly colored and of luxurious and fantastic outlines. The sea floor is of rock, covered with sediment from rivers. Then comes matter derived from fragments of marine plants and animals, shells, skeletons, bones and coral fragments. Sometimes there are meadows filled with sponges and sea plants.

Many so-called marine "plants" are animals, and sinister animals, too. The sea anemones, roses and pinks are, in fact, pirates lying in wait for victims to devour and sate appetites that, like those of most sea animals, are voracious. Anemones are really highly colored animals with tiny myriad tentacles and warts that look like flowers but are far from it.

How deep is the sea? There are fifty depressions or "deeps" known to science, varying from 3,000 to 5,000 fathoms. The greatest is forty miles east of northern Mindanao, in the Philippines, and its depth is 5,348 fathoms, or 406 feet more than six miles. This depth exceeds by 3,000 feet the height of the loftiest mountain peak. The average depth of the ocean is probably not less than 2200 fathoms, about two miles.

THOSE are only some of the wonders of the sea. Many more are unknown as yet, for oceanography is practically a new science that has developed mostly in the past thirty years. There are many important problems still awaiting solution.

"Yes, there are more wonders," Dr. Townsend will tell you with a twinkle in his eye. "There is the planked shad, for instance, and the planked whitefish. Did you ever see one walk the plank?"

"What did you ask? Sea serpents? Tell it to the Marines!"

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See New Financial Department on Page 4—Front Section.



## Ways We Use Waste

(Continued from page 27)

is burned are recovered for use. Fully as astonishing are the new fuels obtained from things which once were considered to have no practical value. In Illinois, for instance, engineers recently proposed a plan to salvage the gas now wasted in the treatment of city sewage, and to employ it for household heating purposes. This gas, they say, is odorless when burned, and has high heating value. In a city of 50,000 persons, they estimate fully 90,000 cubic feet of gas can be obtained in this way.

**A**NOTHER surprising development is a newly discovered method of obtaining high-grade fuel, resembling fuel oil, from low-grade "backstrap" molasses, which until now has been considered a waste product of sugar refineries. This strange sweet fuel does double duty; for the residue, after burning, can be converted into potash and used for fertilizer. The process is the invention of Dr. Paul G. Hildebrandt, chemical and mechanical engineer of Swarthmore College, Pa. In the laboratory he has demonstrated that the fuel obtained from each ton of low-grade molasses has a heating value equal to a ton of coal, and produces 150 pounds of commercial potash besides. He estimates that the salvaging of waste molasses in some 5,000 raw sugar factories in the world will represent a yearly saving of \$22,000,000.

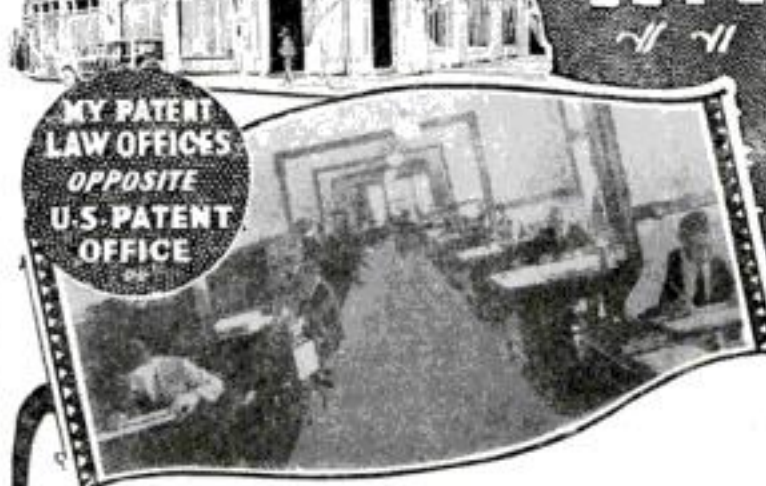
The rapid depletion of our forests has called the attention of scientists to the extravagant waste that goes on in the lumber industry. At least seventy-five percent of every standing tree is wasted, on the average, when it is converted into lumber. This loss is represented in the limbs, stumps, knots and tops of trees, as well as in sawdust and mill shavings.

A few weeks ago Jacques C. Morrell, of Riverside, Ill., and Dr. Gustav Egloff, of Chicago, told the American Chemical Society that they had succeeded in reducing the wastes from Douglas fir into tar. By the chemical process of "cracking," such as is used in making gasoline from crude oil, they split the wood tar up into light volatile oils suitable for motor fuels, solvents, and paint thinners.

**A**LMOST at the same time a bulletin issued by the New York State College of Forestry, Syracuse University, announced experiments showing that waste products of the forest offer a great source of human food. Animals thrive on the leaves, branches, tender twigs, and sometimes the bark of trees; why not men? The Rocky Mountain yellow pine, when examined recently, was found to contain 8.19 percent protein, the food property so important to man. This is nearly as much as the protein content of wheat, which is 12.4 percent, and of field corn, which is 10.1 percent. Before we realize it, choice dishes from twigs and leaves may be a regular part of our bill of fare.

Such a possibility, however, is no stranger than are some of the articles of food, medicines and drugs now produced from things considered worthless. The blood of animals in the (Continued on page 154)

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TRADE-MARKS  
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## Ways We Use Waste

(Continued from page 153)

big slaughter houses, for example, always has been thrown away. Now chemists have found a way of removing the hemoglobin, which gives the blood its red color, and using the residue to make meringues in place of whites of eggs.

From fish refuse, Professor Nils Hanssen, a former head of Sweden's department of agriculture, has produced a flour which he declares is an excellent food for cows and pigs. At Gothenburg, the largest fishing center of Sweden, all refuse now is saved and shipped to a factory where it is converted into the flour and sold to farmers for fattening their live stock. The screenings are used for chicken feed.

**E**VEN old shoes have their value. At Tufts College, Medford, Mass., a young magician of science has succeeded in converting scrap leather into valuable drugs, medicines and perfumes. From seaweed, too, Dr. J. W. Turrentine of the U. S. Bureau of Soils has extracted iodine which has been found effective in the treatment of simple goiter.

The nation's junk piles of metal no longer are being allowed to go to rust and decay. Last year 800,000 tons of metal from the scrap of factories and junk dealers were recovered and turned back to use—a saving of some \$200,000,000. Of the million automobiles which wear out every year and are cast aside, all but a small proportion now are salvaged.

Perhaps the most remarkable example of how modern industry is learning to make use of scraps is found in the salvaging plant which Henry Ford has established at Highland Park, near Detroit. Here 500 men are employed to turn every bit of waste to some useful end whether it be a bit of rope, an old bag, or a piece of paper. When a Ford mechanic wears out a pair of rubber boots they may be turned back into rubber tires. Old leather from shoes or aprons and scraps of new leather are turned into washers, hand pads, gaskets and leather molds used for various types of machines. Old rubber gloves are cut up for finger protectors. Rope, bags and burlap are shredded and put into cushions. Through this endless process of salvage, Ford saves something like eighteen million dollars a year.

**W**HEN Thomas A. Edison was asked some time ago whether he planned to produce any new inventions in the near future he replied: "No, I think it would be better for the world if it waited awhile until it learns how to use the inventions it already has."

He meant to tell us that we are profligate of the wonderful heritage left to us by the creators and discoverers; that we can find unsuspected value in the last scrap, if we will stop a moment in our mad pace and look for it.

HOUSE FLIES have decreased noticeably in number since automobiles came, says a Providence, R. I., health official, because there are now fewer horse stables, principal breeding places of flies.

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## Tunney Tells How He Won the Championship

(Continued from page 29)

the fight. Fighting fire with fire, as it were," smiled Gene.

"Have you ever stumbled over anything in the dark?" he asked me suddenly. "It's about as disturbing an experience as you can have. That's because you're not ready for it, and it was by injecting that same element of unexpectedness into my first punch that I planned to beat Jack Dempsey.

"ANY old punch wouldn't do, though. It had to be a punch that would be sure to land—and one that carried the knockout shock. Study of Jack Dempsey's tactics as he rushed from his corner—motion pictures of his fights were available, you know—soon convinced me that a straight right-hander, timed to the instant and delivered with all the beef and spirit I possessed, was the ticket, so I began practicing that punch. I practiced it against punching bags, with sparring partners; I bombarded the empty air with it in shadow boxing. I even let it loose at odd moments—as when I was waiting for my turn to tee up a golf ball. I went through the motions of delivering it on moving picture sets. Months ago I had it worked out to the utmost perfection of timing and accuracy. And that punch," said Gene Tunney impressively, "won the fight for me.

"It wasn't delivered exactly as I had planned. I couldn't land it in Dempsey's first rush. But in his second rush, out went my right—bang!—the hardest punch I had ever delivered. Jimmy Bronson, my chief second, who knew all about the punch, of course, had told me before the fight, 'Land that right-hander! Break your arm, if you must, but land it!' I landed it all right, but I missed. It was aimed for the point of Dempsey's jaw, but it struck him on the cheekbone. It didn't knock him out, but the force behind it was so great and the timing so exact that he never recovered from that blow. It stunned him physically, and surprised and disconcerted him mentally, so that, as he himself said after the fight, he never got started.

"SUPPOSE it had not had that stunning effect?" I asked.

"I'd have been in for a tough time," responded Tunney simply. "I'd have taken many more terrific punches than the few Dempsey managed to land. However, I was prepared for that, too. I had made certain that I could weather a storm of heavy punches by taking plenty of them on my face and body while I was training. My sparring partners wore football headguards in training. I didn't. I was training to take punishment as well as to avoid and inflict it.

"All the practicing and all the training in the world, of course, would not have assured that decisive blow if I hadn't had absolute confidence that I was capable of doing the job. I had to be so absolutely sure of myself. (Continued on page 156)

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## Tunney Tells How He Won the Championship

(Continued from page 155)

"That's all there is to the trick of becoming heavyweight champion of the world—or anything else that you might aspire to and that lies within your capabilities. If you can convince yourself—honestly—that you can do a thing, you can do it.

"I do believe that anyone, who, after studying his capabilities and talents, is confident that he can become a great artist, singer, inventor, business leader, politician or whatnot, can achieve his ambition. You know quickly whether you're on the right road, for the hardest person in the world to deceive is yourself."

I'VE interviewed scores of famous athletes on the same subject on which I talked with Gene Tunney for POPULAR SCIENCE MONTHLY—themselves, and the "how" of their achievements. Tunney, though, is the first who has given me a satisfactory answer. He knows how he fights, because he fights not with a body directed by native instinct and a mechanical skill acquired by practice, but with his brains. He has been criticised for being a "made" fighter, for lacking the "killer instinct" that all great performers of the ring are supposed to possess. I subscribe to both these criticisms and my hat is off to him in consequence! He's not only a "made" fighter, but a self-made one, and a corking good job he's done of it, too! That he lacks the wolfish ferocity that causes some pugilists to glory in pounding an already beaten opponent into helplessness, in my opinion, redounds to his everlasting credit, for he has won the greatest prize in the gift of the ring without it.

His poise, his self-control, his self-confidence and his courage are admirable.

IMAGINE a man, who, thirty-six hours before the greatest crisis in his life, spends two hours in utter absorption in the task of teaching the elements of golf to a friend who didn't know a niblick from a sand trap!

Imagine a man, who follows that session on the links by going to his room, sinking his head into a book, reading for an hour or more in utter detachment from the world about him!

Imagine a man, who, keeping an engagement which means fame, fortune and the achievement of his life's ambitions, makes his way to the place, over the protests of his well-wishers, in an airplane—the first time he had ever entered one!

Imagine a man, who, dressed in his ring clothes and about to fight for the heavyweight championship of the world, spends the five minutes immediately preceding his entrance to the ring peacefully sleeping in his dressing room!

I saw Gene Tunney do all these things. And so I do not hesitate to call him, as I did at the beginning of this article, the most remarkable young man who ever entered the prize ring, and a young man whose influence as heavyweight champion is bound to reach far beyond the world of sport.

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Advice for POPULAR SCIENCE MONTHLY readers regarding safe and profitable investments. See Page 4



## Is Your House Heated Properly?

(Continued from page 32)

slight argument between the one-pipe circuit and the one-pipe relief layouts. Automatic air valves above the steam mains improve the system. Steam supply mains should slope away from the boiler at the rate of one inch to ten feet, while the return pipes which carry water of condensation must pitch back at least at the same rate to the boiler.

"Pipes that sag or lack the proper uniform pitch cause those unholy gurgles and knocks that some people regard as the inevitable music of a steam plant. A defective air valve at the radiator may also cause the tumult. Sometimes a correct air valve is fussed out of order. Adjust it once and then leave it alone."

"SOME of our friends who have hot water systems recommend them highly," observed Ellen.

"Every Arab praises his own camel, according to the proverb, but in this case your friends are quite within reason. About the only drawback to hot water is the too slim purse of the prospective owner who can't afford long-run economy. Water retains heat and emits it steadily, tending to keep the house temperature more uniform than do other methods. There is no noise, no valve fixing, no pressure question. The same water is used indefinitely, but for that matter a steam boiler requires only a trifling replenishment of water during the season."

"Do we figure hot water size the same as steam?" asked Rob.

"Use the same rule but add sixty-five percent for extra radiation surface needed to compensate for the relatively low temperature of hot water, usually around 180 degrees. This is like vapor compared with steam, only more so. In the example of the steam-heated room we discussed, 46½ ft. of radiation was required. For hot water, adding sixty-five percent, we raise the requirement to 76¾ sq. ft.

"TO GET the boiler size, take the total of room needs, add one third for piping (instead of one quarter as in steam, because there are more pipes) and seventy-five percent for safety margin. Hot water requires double piping—you notice that a radiator has top and bottom connections—also it calls for an expansion tank in the attic. An altitude gage at the boiler tells whether there is enough water in the expansion tank, saving steps to the attic for inspection."

"How does hot water cost compare with steam?" inquired the young man.

"Well, we have already seen that the material for the first is more than half as much again than steam of the ordinary type. Labor for hot water installation is estimated at two and one half to three days for man and helper per radiator; while steam, single pipe circuit, takes but one and one fourth days for man and helper per radiator. While these work estimates are given by an authority, I have seen a small installation of steam done in half the time allowed."



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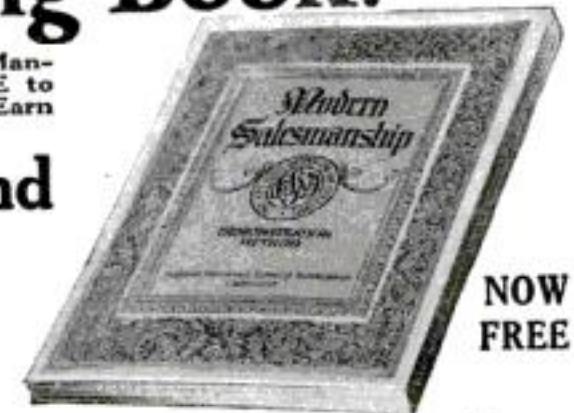
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## Benjamin Franklin, Experimenter

(Continued from page 30)

he says that "it was no small mortification to me, that I happened to be abroad (away from home) during two of the greatest thunderstorms we had early in the spring. I had given orders to my family that, if the bells rang when I was away, they should collect some of the lightning for me in electric phials, and they did so, yet it was mostly dissipated before my return." He was hot upon the trail of lightning.

Picture this highly respected, somewhat rotund citizen upon the floor of his library, on hands and knees. Scattered about him—paper, twine, odds and ends of old silk rags from Mrs. Franklin's scrap bag. His Philadelphia friends were certainly justified in raising their eyebrows. They knew him for an inventor, of course; but if he was perfectly sane, why should he be crawling about in his shirt sleeves with his mouth full of pins or tacks?

Looking back upon all this now, you can get a glimpse of the youthfulness of Franklin. Who but a boy would think of sending up a kite to snatch a secret from heaven?

A KITE. As always, we can find no better words than his own, to describe just how he proposed to construct and equip it.

"Make a small cross of two light strips of cedar, the arms so long as to reach to the corners of a large thin silk handkerchief when extended; tie the corners of the handkerchief to the extremities of the cross, so you have the body of a kite, which being properly accommodated with a tail, loop and string, will rise in the air like those made of paper."

Anyone can follow him so far, and duplicate his construction—always remembering that silk handkerchiefs, in his day of male finery, were larger than they usually are nowadays. A bluejacket's neckerchief might serve the purpose, if it did not prove too heavy, and Franklin takes care to explain why it should be silk.

"This being of silk is fitter to bear the wet and wind of a thunder gust without tearing.

"To the top of the upright stick," he continues, "is to be fixed a very sharp pointed wire, rising a foot or more above the wood. To the end of the twine, next the hand, is to be tied a silk ribband and, where the silk and twine join, a key may be fastened."

HUNDREDS of times, in school readers, histories and other books, Franklin's kite experiment has been described. But one point seems missing—accurate data on weather conditions on the day of the experiment.

Within very recent years kites have been flown by professional scientists just as artificial lightning of tremendous power has been manufactured in laboratories. Results show that it is possible, with a kite flying in clear weather, to get the effects credited to Franklin. But if he had flown his kite (Continued on page 159)



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Advice for Popular Science readers regarding safe and profitable investments. See page 4.



## Benjamin Franklin, Experimenter

(Continued from page 158)

in such weather, snatching down the lightning when there was none visible in the sky, surely he had far too good a sense of the dramatic to miss giving anything so startling the very widest publicity.

On the other hand, suppose he had flown his kite in a real thunderstorm? A frightfully dangerous thing to do. We should then have had no Franklin to improve the Declaration of Independence; no Franklin to be a successful Minister to France.

Early biographers and historians knew little about electricity; they could not check up the scientific side of the experiment. And Franklin left behind no exact date, from which it might be possible to discover what the weather actually was on that memorable day. No one will ever know the exact conditions of the great test, but here is his description of the method and the result:

"THIS kite is to be raised when a thunder gust appears to be coming on, and the person who holds the string must stand within a door or window or under some cover, so that the silk riband may not be wet; and care must be taken that the twine does not touch the frame of the door or window. As soon as any of the thunderclouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified and the loose filaments will stand out everywhere and be attracted by the approaching finger, and when the rain has wet the kite and twine so that it can conduct the electric fire freely, you will find it stream out plentifully from the key on the approach of your knuckle, and with this key the phial may be charged.

"And from electric fire thus obtained spirits may be kindled and all other electric experiments performed which are usually done by the help of a rubbed glass or tube, and thereby the sameness of the electric matter with that of lightning completely demonstrated."

Scientists now suggest that the current was induced, that is, created by influence across a space, not by actual contact. If the kite string had been wet enough to make a good conductor, bringing the current down to the key, it is hard to believe that the "loose filaments" of the string would "stand out everywhere." But, explain it as you please, the conclusion—that lightning and electricity are the same thing—cannot be denied. Most of us, in spite of the difficulty of understanding how he did it, leave Franklin with the credit for that discovery.

**L**IGHTNING takes many forms, often unnoticed because we are not as a rule enthusiastic about thunderstorms. Zigzag flashes are not really zigzag at all; the flashes curve and wind, more like a river between its banks. "Sheet" or summer lightning is chiefly the effect of reflection against the clouds, so far away that we hear no thunder. The globular type is more

(Continued on page 160)

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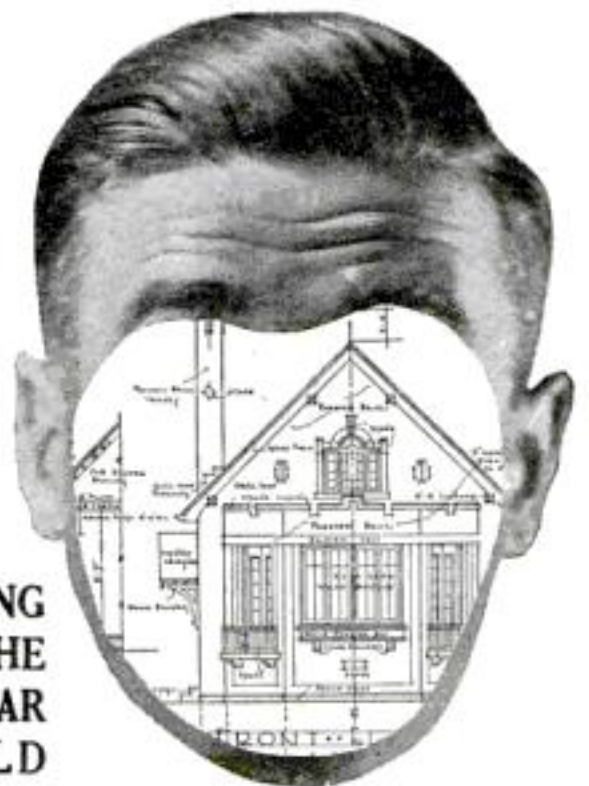
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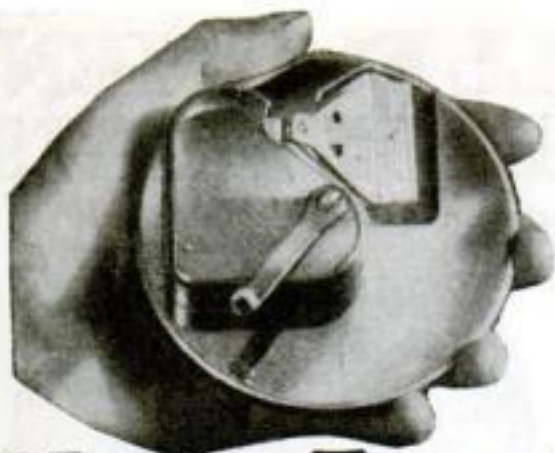
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## Benjamin Franklin, Experimenter

(Continued from page 159)

rare, but the writer once watched such a ball roll down through a pine tree, fifty feet away, splitting it from top to bottom almost as neatly as a golden circular saw, about the size of the sun as it ordinarily appears to us, might have done it. And there is the recorded case of such a ball tumbling into a room, rolling across the floor and out through a crack in the wall without injuring any of the occupants.

"Ribbon" or multiple lightning, still more rare, is due to a number of parallel flashes, so close that they seem to make one long ribbon.

DOCTOR STUBER, a contemporary of Franklin's, is said to have known him well and to have got from him the story of the historic afternoon.

"His kite," says Stuber, "was raised—a thundercloud passed over it—no sign of electricity appeared. He almost despaired of success, when suddenly he observed the loose fibers of his string to move toward an erect position. He now presented his knuckle to the key, and received a strong spark. How exquisite must his sensations have been at this moment! On this experiment depended the fate of his theory. If he succeeded, his name would rank high among those who had improved science; if he failed, he must inevitably be subjected to the derision of mankind, or, what was worse, their pity. Doubts and despair had begun to prevail, when the fact was ascertained in so clear a manner that even the most incredulous could no longer withhold their assent."

WAS Doctor Stuber accurate in his account? It is too late, now, to find that out. But nobody can deny that it is a fascinating picture of Franklin that he gives us.

What other moment of his life could compare with that one? To stand up to a withering fire of questions by an English Parliament was one great hour. To stand up in the American Constitutional Convention and suggest equal state votes on matters of sovereignty—in other words, to save the Constitution by sowing the seed of today's Senate as a means of securing really equal representation—was another great hour.

But to be left standing out of doors facing single handed the greatest force in nature and sharply outlined against the blazing, crashing heavens?

Printer, politician, inventor; author, diplomat, and pioneer American scientist: could Franklin himself have demanded more of fame than that?

LENGTHENING the life of sponges by passing them through machines with spiked rollers so as to increase the honeycomb, is the idea of a Turkish inventor. After the sponges are brought up by the divers and cleansed of "milk," they are washed, partially dried, and then perforated wherever cavities are necessary for effectually cleansing them after everyday use.

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See New Financial Department on Page 4—front section.



## Our Haphazard Signs

(Continued from page 39)

foot off the accelerator, or maybe even step on the brake, and drop to fifteen or twenty miles before you pick out the other words. Then, if you're in a hurry, you open up again, with language rising involuntarily within you. And a little later on, when you see another big STOP you slide along at thirty-five, until suddenly you notice that it reads—

### STOP!

#### Dangerous Intersection

Well, maybe that time it doesn't make any difference. And then again, maybe it does. Every state in the Union ought to legislate misleading and dangerous advertising signs out of existence.

AGAIN, in the case of route signs and directions, there's an astonishing discrepancy between the best signs and the worst.

More and more, now, the states are taking up the practice that started in Wisconsin, of marking route signs by number. We followed them quite easily through half the country—"Number 22," say, through Illinois, or "Number 14" through Missouri. On some of the main trails, such as the National Old Trails coast to coast highway, we found fairly clear markings a good part of the way, in red, white, and blue bands around the telegraph poles.

But if you want a real grade-A puzzle, try to find the National Old Trails highway, or any other, from Philadelphia to New York. Any stranger who can turn that trick without stopping about seventy-one times to ask directions is entitled to be best man at a wedding, or anywhere else. Try it in New Jersey around Newark, or Elizabeth, and into Jersey City.

Cities and detours are the two things that make tourist routes particularly hard to follow. For a city solution, we can turn to Maryland again. There, at the city outskirts on most of the main route highways, we found big signboard maps with the through route clearly marked.

DETOURS are, to be sure, always an abomination. When we went through Ohio and Michigan we found the trouble reduced to a minimum by splendid markings for every corner. Even though the detours were sometimes bumpy, they could at least be followed easily. But many states are not so careful.

In the first place, there's a world of difference in the ways road commissioners steer you into detours. In some states an effort is made, whenever possible, to do half a road at a time, and allow travel to continue, with as little difficulty as possible, down the other half of the road, by providing places where two cars could pass, or widening the wing enough to make two lines of traffic possible, a lot of time and trouble is saved motorists.

In other places the road commissioners block off highways for miles, causing needless delay and expense for the very public they are supposedly trying to benefit. Again we found (Continued on page 162)

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## Our Haphazard Signs

(Continued from page 161)

the East behind the West in this respect. Hardly a highway in the country, for instance, carries more traffic than the Boston Post Road. Yet the history of that thoroughfare, for the last ten years, is almost unbelievable. If I could have a dollar for every bump on the head I've had from hitting the top of the car on a detour from the Boston Post Road, I'd give the road commissioners a dinner.

IN KANSAS, Oklahoma and adjacent regions, to add to the gaiety of motorists, we found that a neighborhood rivalry had developed over routes. We would be traveling, let's say, on the Southwest Trail. Conflicting signs set up by rival counties or communities that also wanted our trade, would have steered us off to the Coast to Coast Highway or some other trail.

Then, there's the confusing trick of insisting that you see the center of every town you pass through. Even though the main route goes, or should go, clear at the edge of the town, we would be shunted by the signs over to the main street, through the thickest traffic, and then back again.

Varying state laws concerning speed and city regulations for traffic, we found, are still another source of trouble and danger. But this particular source of irritation has already been discussed in a recent issue of POPULAR SCIENCE MONTHLY. I would add only this:

Maryland and a few other states have set up, where the main highways cross the state line, big signboards with the principal state road regulations and speed laws clearly outlined on them for visiting motorists. That's a step worth copying.

Finally, there's the question of hand signals. Motordom's millennium will have arrived when, and not before, the prescribed warnings from one motorist to another are as uniform as we'd like to have the traffic regulations.

ON THE Pacific coast, the generally accepted signals are: Hand up for a right turn, straight out for a left turn, and down for a stop. But we found that a good proportion of the Middle West waves its arm in a circle for a right turn, holds it straight out or waves it in the opposite direction for a left turn, and holds it up for a stop. In the East one set of signals prescribes that you point straight out with your finger if you're going to make a left turn; point at your own head as if you wanted to shoot yourself for a right turn; and hold your hand straight out with the palm turned back if you're going to stop.

But the most widely accepted rule in the East—at least around the larger cities—is just to dangle your hand over the left side of the car as a warning that you're going to do something. The fellow behind you has no idea what it may be; possibly you don't know yourself. But at least—unless you're merely knocking the ashes off a cigarette—he's had a fair warning that you're going to do something; and from then on he travels at his own risk, as well as yours.



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POPULAR SCIENCE MONTHLY

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## Thrills of Modern Explorers

(Continued from page 42)

tide rises and falls, gates in the dams permit maintenance of differences in water level during part of the tidal cycle. These differences produce the necessary heads of water for the production of power through turbines.

They are trying it out now in England and France, says Mr. Marmer, to see how much "white coal" they can get from the ocean. On the Severn in England, with a twenty-foot tide range, and near Brest in France where it is over fifteen, experiments are being made.

## "Pegasus, or Problems of Transportation"

By Col. J. F. C. Fuller. Published by E. P. Dutton & Co.

"PACIFIED tanks," roadless vehicles with caterpillar treads, can be the means of opening to commerce the remaining frontier countries of the world. War monsters that ten years ago first crunched their way over German trenches can now, in peaceful guise, overrun trackless countries and place at the world's disposal their untouched riches, at the same time opening them to Europe's surplus population. The remaining frontier countries of Africa, Asia, the British Dominions, South America, even our own Philippines or Alaska can thus be won far more rapidly than the "Iron Horse" won the American West.

This is the belief of Colonel Fuller, former chief of staff of the British tank corps, and he bases it not only on experiments made in England, but on the recent exploit of Citroen caterpillar cars in crossing the Sahara. Tanks, he points out, need have no tracks laid for them, nor roads made; they need neither coal nor wood. This keeps the expense down; such vehicles, carrying a twenty-ton net load, can be run for slightly less than four cents a ton-mile, including overhead charges, depreciation, interest and all running charges.

THE vistas this plan opens are limitless and, as the tank expert points out, not so visionary. The latest British tanks make twenty miles an hour, and there are amphibious tanks that carry cannon across streams. A tank scaled the Palisades of the Hudson not long ago. What tanks can do, peaceful roadless vehicles can do, too. What other vehicle is there that can go safely about anywhere except over a precipice? Not locomotives, trolleys, trucks or wagons. Yet most of the world is still roadless.

So Colonel Fuller's plan is to open with roadless vehicles, the "back country" that railroads do not reach. The wealth created will permit building new railroads later. He sees two types of pacified tanks. The smaller type with wheels in front and tracks in rear, would gather the produce from village, mine and farm and draw it to intermediate stations. Here it would be shifted to monster types, all tracked, plying between these stations and railroad termini.

## They Laughed When I Sat Down At the Piano But When I Started to Play!—

"Can he really play?" I heard a girl whisper to Arthur, as I sat down at the piano. "Heavens, no," Arthur exclaimed. "He never played a note in all his life."

Then I gave them the surprise of their lives. I started to play. Instantly a tense silence fell on the guests. I played the first few bars of Beethoven's immortal Moonlight Sonata. I heard gasps of amazement. My friends sat breathless—spellbound! I played on.

### A Complete Triumph!

As the last notes of the Moonlight Sonata died away, the room resounded with a sudden roar of applause. Everybody was plying me with questions. "Jack, why didn't you tell us you could play like that?" "Where did you learn?" "Who was your teacher?"

### Then I told them the whole story

"It seems only a few months ago that I saw an ad of the U. S. School of Music mentioning a new method of learning to play which only cost a few cents a day! Without a teacher! And no laborious scales or exercises. I sent for the Free Demonstration Lesson and was amazed to see how easy it was to play this new way. I sent for the course and found it as easy as A.B.C. Before I knew it I was playing all the pieces I liked best. I could play ballads or classical numbers or jazz, with equal ease! And I never did have any special talent for music!"

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## Here Are Correct Answers to Questions on Page 48

1. At the small town of Summerland, Calif., oil seepages were noticed at the seashore. Some of the wells drilled actually are out under the ocean. The derricks and pipe lines are built on stilts several hundred feet off shore.

2. According to the census of 1920, the center of population was located in Owen County, Indiana. Fifty years ago it was near Cincinnati. It is slowly moving west, as the settlement of the Western states increases.

3. In the summer, northern Alaska has days twenty-four hours long. On the other hand, the winter season brings continuous night.

4. In the bottom of the valley in which lies the City of Mexico, there are still several small lakes. In one of these, Lake Xochimilco, natives have built gardens on masses of peat that float on the surface of the water. Here are raised most of the fresh vegetables that the City of Mexico consumes.

5. Off the coast of southern Florida the current of the Gulf Stream averages about two miles an hour.

6. South America. Vast areas in western and southern Brazil, in northern Bolivia and in the interior of Colombia and Venezuela have never been examined with completeness by civilized people. Even in Argentine there are areas which are imperfectly known.

7. This famous building is an ancient fortress, still standing on a slight hill within the city of London on the north bank of the Thames River.

8. All through the equatorial or middle part of Africa the natives communicate from village to village in this way. The codes by which messages are sent are not well understood by the whites, but news is spread in this way with great rapidity.

9. Near the ancient city of Thebes in southern Egypt, not far from the modern town of Luxor, there still stand two large statues cut out of stone by the ancient Egyptians. It is said that the heat of the rising sun caused the stone of one of the statues to expand so that a sound was produced as though the statue spoke.

10. This is a custom in the southern part of India, where certain kinds of so-called "edible earth" are common articles of commerce. Balls of this earth may be purchased almost anywhere in the bazaars. The reason for this curious custom is obscure. The earth contains little nutriment, if any, although it is barely possible that some of its mineral constituents, for example, iron, may be slightly beneficial to the health.

11. This was one of the customs of the native kings who ruled the Hawaiian Islands before the conquest of these islands by the whites. These cloaks were made from the feathers of a small bird native to the islands. Many women worked for a lifetime collecting and piecing together enough of the feathers to make a cloak for the king.

12. The tallest known ferns exist in the Hawaiian Islands, where they grow to a height of thirty or forty feet.

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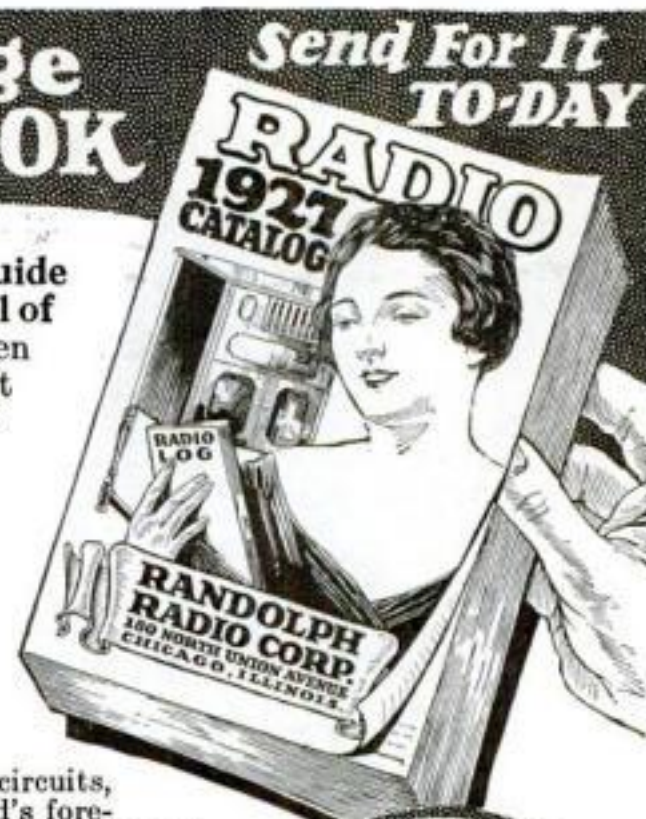
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The celebrated Miraco Ultra-5—U.S. Navy type circuit, has also been adapted to Single Dial Tuning—without sacrifice of selectivity, volume, clearness, power, tone, or distance getting qualities! In the magnificent big Miraco Unitune-5, above shown, you turn one vernier knob for stations everywhere. Beautiful hand-rubbed, piano hinged, solid walnut cabinet, 28 in. long, 15 in. deep, 10 in. high. Sloping Bakelite panel is walnut finished to match. Also offered on 30 days free trial!

## Coast to Coast and Foreign Reception Certified by Miraco users

**MIRACO RADIO GETS 'EM COAST TO COAST**

Send for Proof!

### USER-AGENTS WANTED . . WRITE!

Reports from users everywhere leave little for us to add. These are only a few of the many in our files and which we receive daily. Send coupon for plenty of additional proof and testimony of nearby users.

**HAS NO EQUAL FOR TONE, VOLUME, DISTANCE.** North Wildwood, N.J. Miraco best packed set I ever saw shipped. Words cannot express the wonderful tone quality volume, and distance. First night received 47 stations on Loudspeaker. Up to last night, the 5th day, I have received exactly 100 stations; farthest is KGO, Oakland, Calif., on loudspeaker. Also Porto Rico, Cuba and Canada. Francis B. Leo.

**ONE QUALITY PLEASES EVERYONE.** Philadelphia, Pa. Everyone that hears the Miraco is very pleased with tone, distance, etc. Tuned in during international test week; KGO, Oakland, Calif.; CYR, Mexico City, Mex.; KXW, Cuba; 2EH, Edinburgh, Scot.; also a station in Buenos Aires, Argentina. Geo. W. Hill, Jr.

**WISCONSIN HEARS COAST TO COAST.** Racine, Wis. I got station 2LO London last Wednesday night on my Miraco. Heard a choir sing and announcement. Have also heard P.W.K. Havana, Cuba; CYZ, Mexico City and 104 American stations from coast to coast. Lawrence Risberg.

**SELECTIVITY!—CUTS THROUGH STRONG LOCALS.** Detroit, Mich. I am more than satisfied with my Miraco. I can cut through W.W.J. W.C.K. W.J.R. W.G.H.P. very strong local stations, and this is done with quarter of a turn. In every way it is simply perfect. Charles Paul.

**UTAH ENJOYS COAST TO COAST PROGRAMS.** Heber City, Utah. The Miraco sure can't be beat at any price. Coast to coast it runs does and more. I have had stations in New York and Cuba in the east, and scores of other stations on the west coast. I have logged up to date 150 stations and they all come in wonderfully. Monte Giles.

**MIRACOWINS AGAINST 3 OTHER MAKES.** Pearland, Texas. I tried three other makes and the Miraco is the best of them all. Received KFI, Los Angeles, Calif., on loudspeaker, O. H. Richards.

**Narcocoches, Texas.** On my Miraco I have heard stations from Cuba to San Francisco and from Mexico City to Pittsburgh. Walter M. Frisbie.

**COAST TO COAST LOUD AND CLEAR.** Guthrie, Minn. We logged over 30 stations and got over 1500 miles on the loud speaker the first night—our first experience tuning a radio. The third night we got WJAX Jacksonville, Florida and KFI Los Angeles, Calif., on the loudspeaker. Neighbors say Miraco is the best they have ever heard. O. R. Wolf.

**MIRACO BEATS A SUPER EIGHT.** Cobalt, Ontario, Canada. Miraco is one of the best radios in all the north country. There is a man here who has a big Super eight and our Miraco beat it. W. Sammler.

**OUTPERFORMS SOME \$300 SETS.** Blacksburg, Va. I am well pleased with my Miraco. It does better than machines that cost \$300 or more. J. D. Tison.

**Notice!** Enormous sales of the celebrated Miraco big fine Receivers (resulting from delighted users so highly endorsing them to friends) again enable us to add hosts of entirely new features, latest refinements and up-to-the-minute improvements such as you might expect to find only on much higher priced sets. Miraco's this year are still better—more beautiful—more selective—more powerful for less money than ever before.

**MOST SELECTIVE—SUPERIOR TO \$120.00 SET.** Santa Cruz, California. I do not hesitate to show my friends the "Miraco Superiority" over my (names another set) costing \$120.00. The Miraco is the most selective set I have seen yet and cuts out the jumble of stations on the low wave lengths in 1 1/2 points. Wm. Schmette.

**MELLOW TONE—LOUD AND CLEAR.** Indian River City, Fla. A wonder set. Am having splendid results. Have had Miraco four nights and have stations on my list from Cuba to New York, Chicago, Denver, Texas, all coming in loud mellow in tone and clear. I have one sold already and did not even try. Mr. H. G. Duff.

**REFUSED TO TRADE IT FOR EXPENSIVE SET.** Prosper, Ore. Over 31 stations brought in first night on loud speaker. I considered the Miraco for a friend and he is more than pleased. I offered to trade my Neutrodyne for it but he refused and it has the name of the best set in the community. M. E. Hulston.

**PENNSYLVANIA BEGINNER GETS 'EM ALL OVER.** Curry, Pa. Have had Miraco one month today and have received over 115 stations from all parts of the United States, Canada, Cuba, and Mexico. I think this is pretty good for one that never had any experience before. Clarence Drugfelder.

**LIKES IT BETTER THAN \$150 TO \$250 SETS.** Westville, Ill. Miraco sure is a wonderful set. I get the stations easily without noise—that's one of the things I like about the Miraco. I've had three other sets that have ranged from \$150 to \$250 each but Miraco beats them all. My friends all like the Miraco. I have had stations all over the U.S.A. I tune in Mexico City and Havana. Cuba any time they are on the air. Alex Kinder.

**BEATS COSTLIER SETS WITH MORE TUBES.** Lexington, O. I have given Miraco a thorough try out and find it to do all you claim. 85 stations logged so far getting new ones every week. This list includes coast to coast, Canadian, Cuban and Mexican stations. The selectivity is remarkable. Others here in town have more expensive and elaborate sets with more tubes but do not ever do this. Fuller Temple.

**MIRACO OUTPERFORMS THEM ALL.** St. Francis, Kansas. I've heard a lot of radios but the Miraco is best all around. I am proud of mine. Comes in fine and clear. No noises. Get lots of distant stations. Surely am satisfied. Orvey Sharpe.

**Send coupon for Amazing Special Offer!**



Solid Walnut Cabinet

Unitune 5

28 in. long

ULTRA-SELECTIVE LONG DISTANCE 5 TUBE SETS EASY ON BATTERIES

# Big Powerful New MIRACO Ultra 5

Solid Walnut Cabinet

27 in. long

Unless Trial Proves Your Miraco the Most Selective, Clearest Toned, and Most Powerful Distance Getter—Don't Buy it!

No need to wear out expensive batteries burning 6, 7 or 8 tubes when users everywhere are reporting that the big latest Miraco 5-tube sets actually are unsurpassed (even at much higher prices) for razor-edge selectivity, extreme long distance reception, clear natural tone and powerful loud speaker volume combined with great economy in use of battery current! Enjoy a powerful Miraco 30 days in your home—at our risk—and be convinced! Your verdict final—absolutely no strings to this. Save or make a lot of money on sets and accessories this season by sending **IMMEDIATELY** for our Amazing Special Offer! Deal Direct with a Big Reliable Corporation

Remember this offer is made direct to you by a big responsible manufacturing corporation—one of the oldest and most successful set-builders in the industry—a concern which has grown to immense size thru recommendations of its many thousands of satisfied customers who bought after trial.



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"For years the Midwest Radio Corporation of this city have been very satisfactory customers of this Bank, one of the largest in Southern Ohio. The Midwest organization was one of the very first to engage in the manufacture of radio sets, and to us their success is evidenced by the sound and steady expansion of their business which we have observed year after year. We are personally acquainted with all officers of the Corporation and from experience know them to be men of honor, integrity and ability. We consider them to be both morally and financially responsible. They have a reputation for fair and square dealings." THE PROVIDENT SAVINGS BANK & TRUST CO. Member Federal Reserve System. Capital and Surplus over \$3,000,000.

Midwest Radio Corporation Pioneer Set Builders Cincinnati, O.

All the Proof you want is waiting for You!

Coupon or postal brings reports from hosts of users in your vicinity and elsewhere proving that Miraco sets at rock-bottom money-saving factory prices, outperform sets costing up to four times as much. You can also buy speakers, tubes, batteries, etc., at big savings from us!

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**NOTE:** This offer is made to prospective buyers by famous big Radio Corporation, one of America's oldest reliable manufacturers of fine sets—seventh successful year. Many satisfied users in every state. Postal or coupon brings testimony of nearby users and proof Miraco's outperform sets costing up to 4 times as much. Very easy to install and operate.

**AMAZING SPECIAL OFFER** to User-Agents who will allow friends to listen to their Miracos.

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